SEPTEMBER 11, 1959

ONE SHILLING AND SIXPENCE

THE AEROPLANE and ASTRONAUTICS

FIRST FARNBOROUGH SHOW REPORT

The Blackburn NA.39 Low-level Strike Aircraft is entirely protected with—

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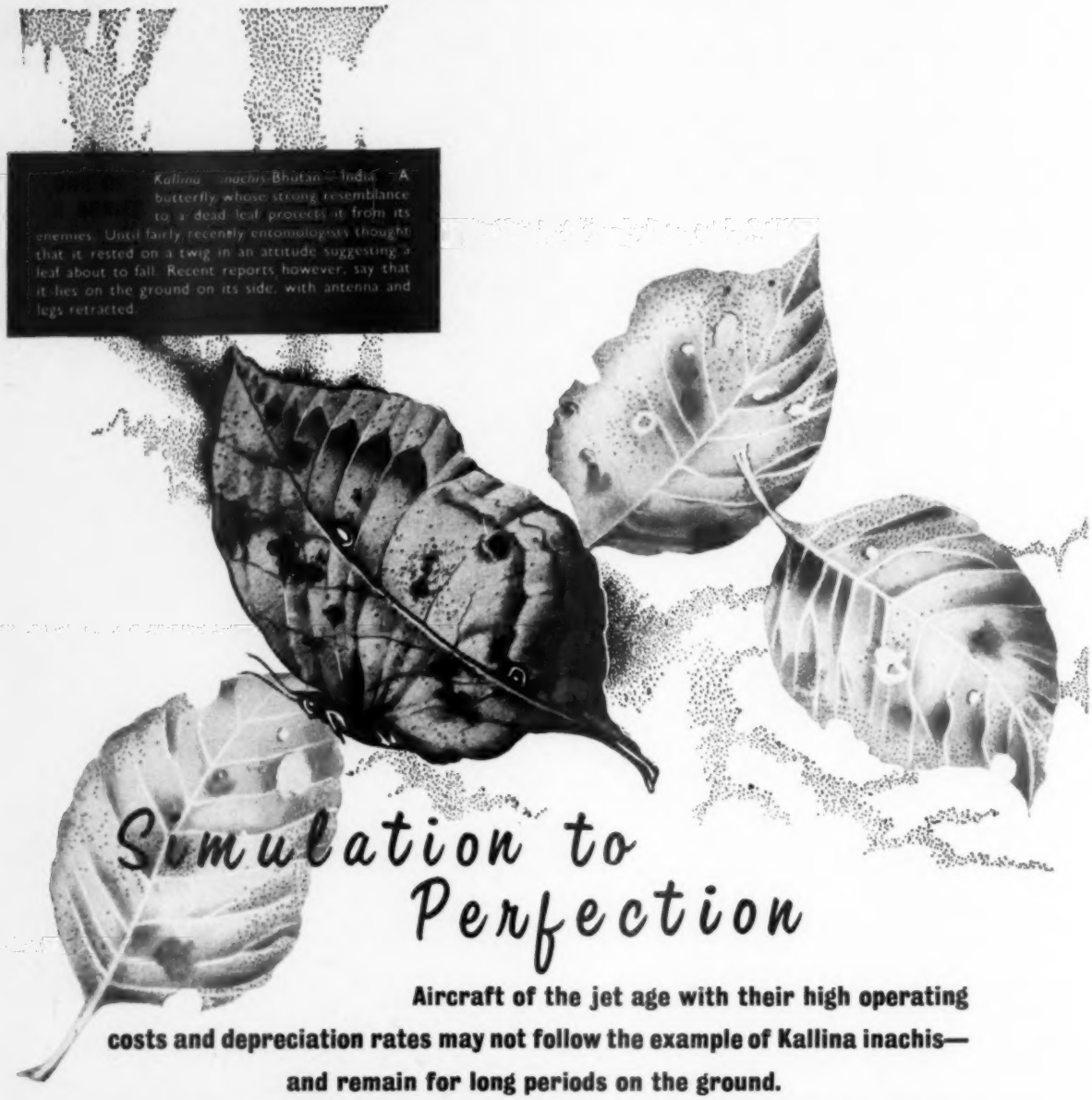
CELLON LIMITED, KINGSTON-ON-THAMES, ENGLAND TELEPHONE KINGSTON 1234 (9 LINES) TELEGRAMS "AJAWB, PHONE, KINGSTON-ON-THAMES"
ALSO MANUFACTURED IN AUSTRALIA, CANADA, FRANCE, HOLLAND, INDIA & NORWAY



Kallina inachis Bhutan — India. A butterfly whose strong resemblance to a dead leaf protects it from its enemies. Until fairly recently entomologists thought that it rested on a twig in an attitude suggesting a leaf about to fall. Recent reports however, say that it lies on the ground on its side, with antenna and legs retracted.

Simulation to Perfection

Aircraft of the jet age with their high operating costs and depreciation rates may not follow the example of Kallina inachis—and remain for long periods on the ground.

We at AIR TRAINERS LINK simulate the modern jet aircraft to such an extent that our ground based equipment enables the air-crew to carry out their training commitments and periodic checks at a fraction of the aircraft's operating cost. *ASK US TO SHOW YOU HOW.*

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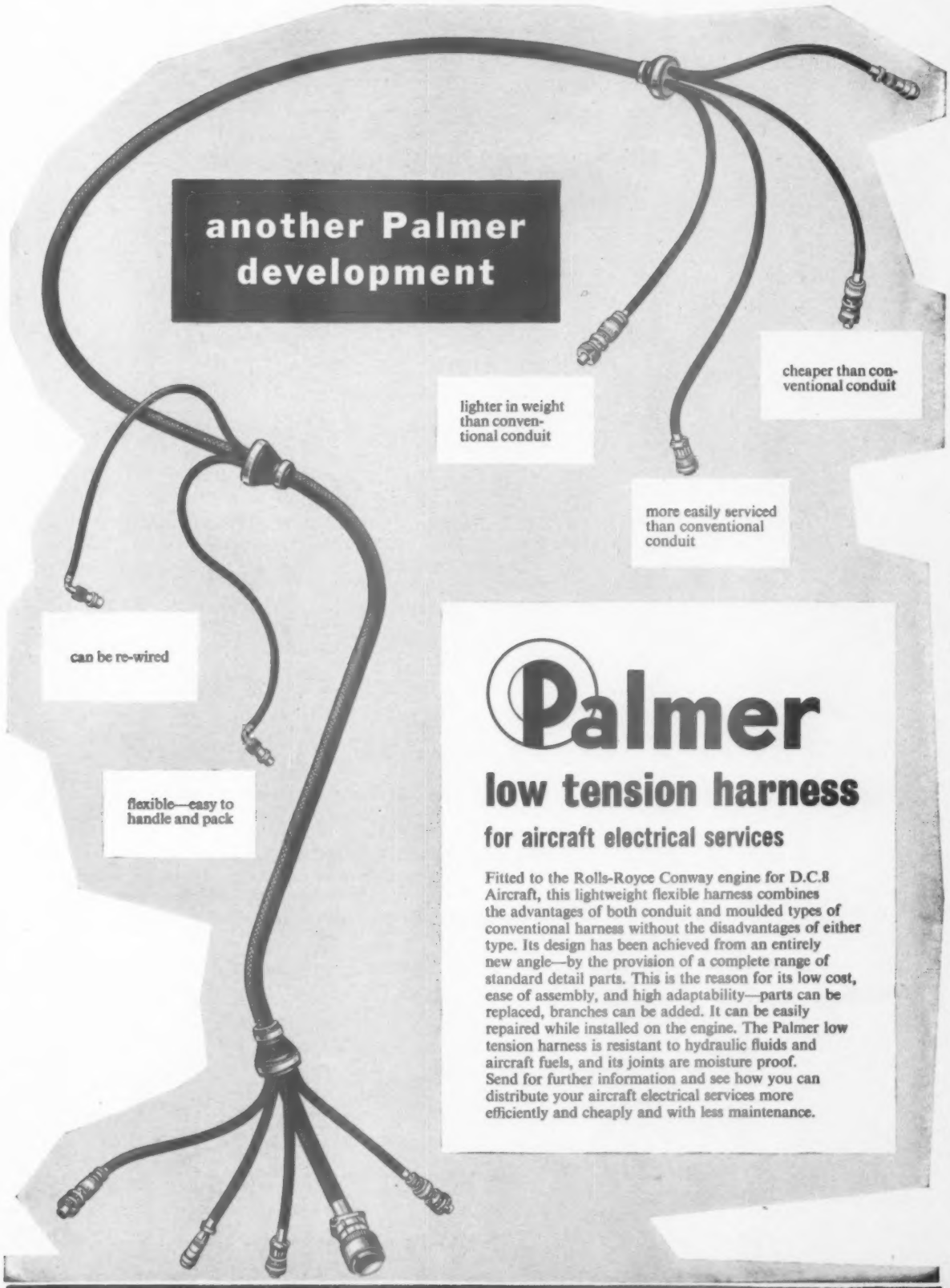

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cheaper than conventional conduit

more easily serviced than conventional conduit

can be re-wired

flexible—easy to handle and pack

Palmer

low tension harness

for aircraft electrical services

Fitted to the Rolls-Royce Conway engine for D.C.8 Aircraft, this lightweight flexible harness combines the advantages of both conduit and moulded types of conventional harness without the disadvantages of either type. Its design has been achieved from an entirely new angle—by the provision of a complete range of standard detail parts. This is the reason for its low cost, ease of assembly, and high adaptability—parts can be replaced, branches can be added. It can be easily repaired while installed on the engine. The Palmer low tension harness is resistant to hydraulic fluids and aircraft fuels, and its joints are moisture proof. Send for further information and see how you can distribute your aircraft electrical services more efficiently and cheaply and with less maintenance.

Palmer Aero Products Ltd PENFOLD ST LONDON N.W.8

AERO PRODUCTS DIVISION · BTR INDUSTRIES LIMITED

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GOODYEAR
AVIATION DIVISION

ANNOUNCEMENT

THE GOODYEAR TYRE AND RUBBER CO. (G.B.) LTD., in conjunction with ELECTRO-HYDRAULICS LTD., are pleased to announce a manufacturing agreement whereby Electro-Hydraulics are producing all Goodyear-designed wheel, brake and associated hydraulic equipment formerly produced at Wallasey.

Under the new arrangement Goodyear retains responsibility for design, modification and repair of all equipment save the hydraulic brake controls, for which Electro-Hydraulics will be the design authority and the supplier.

Goodyear's facilities at Wolverhampton and Hounslow are being expanded to provide increased sales and service in the U.K. and to further assist Goodyear's world-wide field organisation with sales and service in the Export markets.

Aero tyre production is not affected by the Agreement and will continue at the Wolverhampton Factory.

This action is looked upon by Goodyear as a consolidation of their position in the Industry and by Electro-Hydraulics as an extension of their service, supplementing hydraulic systems and undercarriages with hydraulic brake controls.

EH
LIMITED

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IN THE VANGUARD

The Vickers Vanguard, the outstanding new turbo-prop airliner,

introduced by Vickers-Armstrongs (Aircraft) Limited, incorporates materials

produced by British Aluminium, who share the confidence

of the manufacturers in the bright future of this magnificent aircraft.

STAND 170
S.B.A.C. Exhibition, Farnborough

The BRITISH ALUMINIUM Co Ltd

NORFOLK HOUSE ST JAMES'S SQUARE LONDON SW1

AP 363

SYMBOL OF AIRLINE ACHIEVEMENT

BEA will soon be adding the Comet 4B jet airliner to its fleet of Viscounts—the largest in the world. BEA already provides greater variety and frequency of flights over Europe than any other airline.

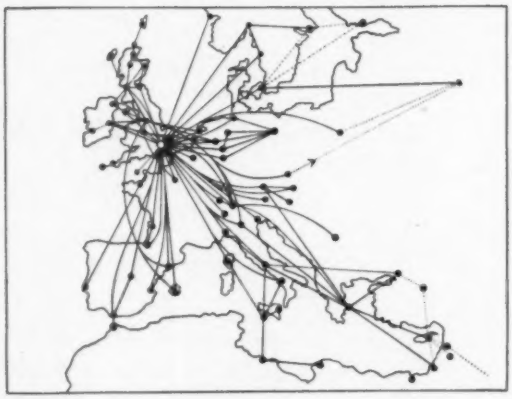
BEA carried 2,828,715 passengers during the year ending 31st March, 1959.

BEA aims to provide air services to an ever increasing public.

BEA continues to press for cheaper fares on regular services in order to bring air travel within reach of everyone.

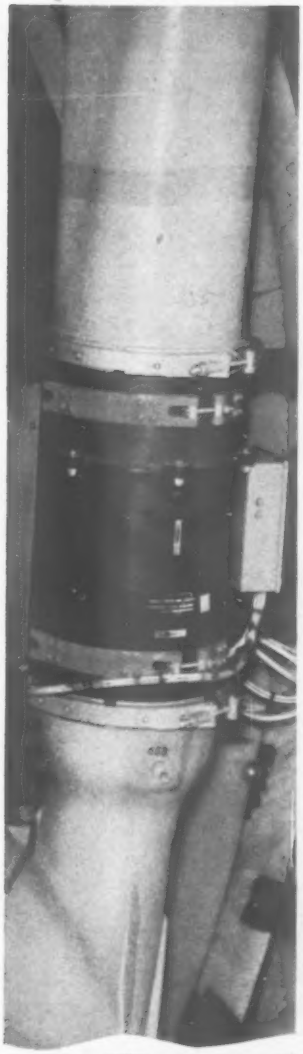
BEA earns a third of its revenue abroad including nearly $5 million last year.

BEA has now operated profitably for five consecutive years.



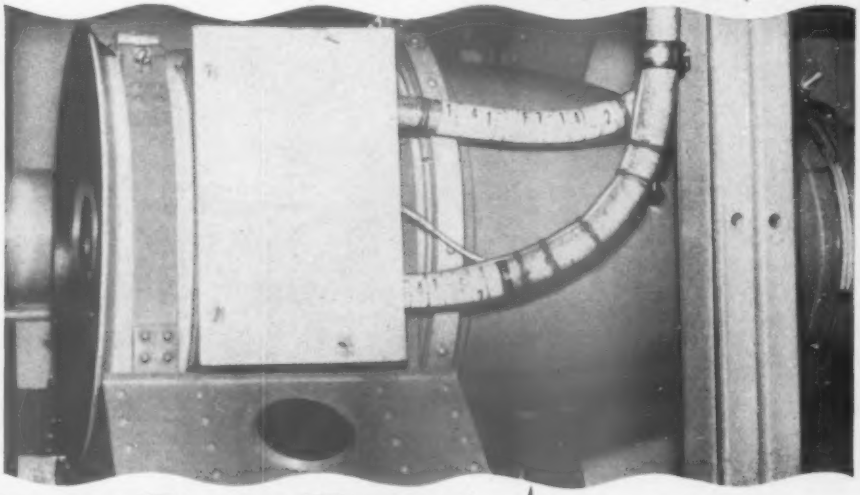
BEA

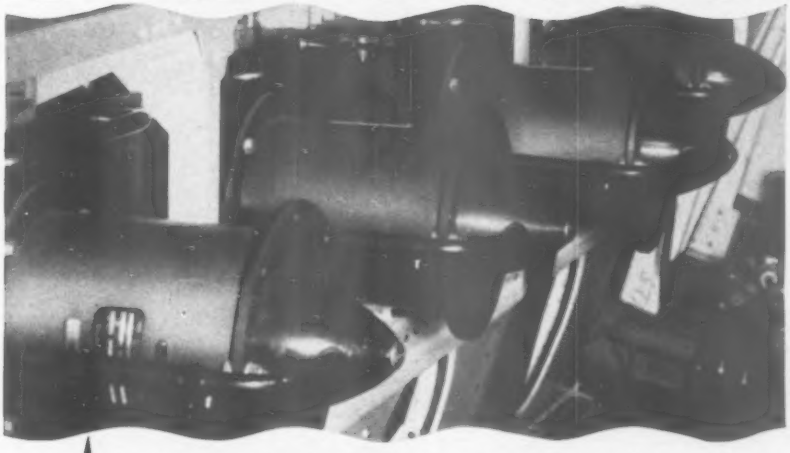
EUROPE'S FOREMOST AIRLINE



Plannair blowers in the Vanguard

LOUVRE BOOST. Single stage axial flow blower unit 6PL161-248 operates on 27/28 volts D.C. running at a speed of 6,000 r.p.m. approximately with an output of 550 c.f.m. at 3" s.w.g. measured at Sea Level. The unit is complete with radio suppression gear and functions as a louvre boost blower for air supply to the cabin.





CABIN RE-CIRCULATION. This unit (9PL241-274) has been designed and produced for re-circulation of cabin air. For its size it is particularly powerful having an output of 1,280 c.f.m. at 15¼" s.w.g. when running at a speed of 7,900 r.p.m. When operating on 27 volts D.C. the current input to the motor amounts to 160 amps. The motor, which has been specially developed for this blower, embodies unique cooling features for providing self cooling and these include internal re-circulating fan with air drawn through a hollow shaft. Thus the motor despite its high output is completely enclosed.

PLANNAIR

TRANSFORMER RECTIFIER COOLING. Illustration shows four single stage blower units type 3PL241-110 installed for transformer/rectifier cooling on the main D.C. power supply unit. Each blower operates on 200 volts, 3 phase, 400 cycles at a speed of 11,200 r.p.m. and gives an output of 150 c.f.m. at 4" s.w.g. at design point at Sea Level. Four 4PL121-359 blowers are used for general cooling of the radio crate and each of these is fitted with dual centrifugal switches for operating warning light and switching on stand-by blower in the event of motor failure.

Stand No. 65

at the SBAC Exhibition

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- **MOTORISED UNDERWING PRESSURE HYDRANT DISPENSER** for flow of 600 gallons per minute, meeting the latest Jet requirements.

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offering a guaranteed calibrated filtration covering the range of micro-filtration from one micron to the coarser filtration up to one-thousand microns. Suitable for all fuels, chemicals, air, etc. . . .

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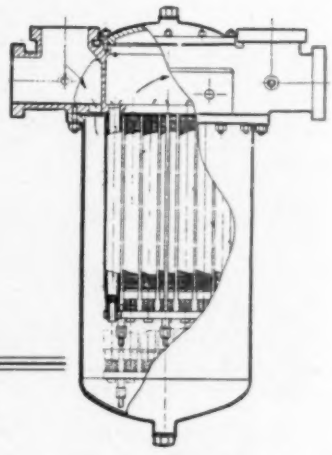

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Beaufort's latest liferaft development provides a reversible multi-seater liferaft with an instantly inflatable self-positioning and permanently attached canopy

demonstrations arranged anywhere

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No restrictions of boarding positions since survivors can jump straight into the liferaft— and if they do have to enter from the water there is an inflated boarding ramp.

★ FULL CANOPY PROTECTION.
No heat exhaustion in the tropics and no exposure problem in the arctic, since the inflatable canopy design allows a wide range of adjustment by the survivors.

★ HIGH TENSILE FABRICS AND SYNTHETIC POLYMERS.
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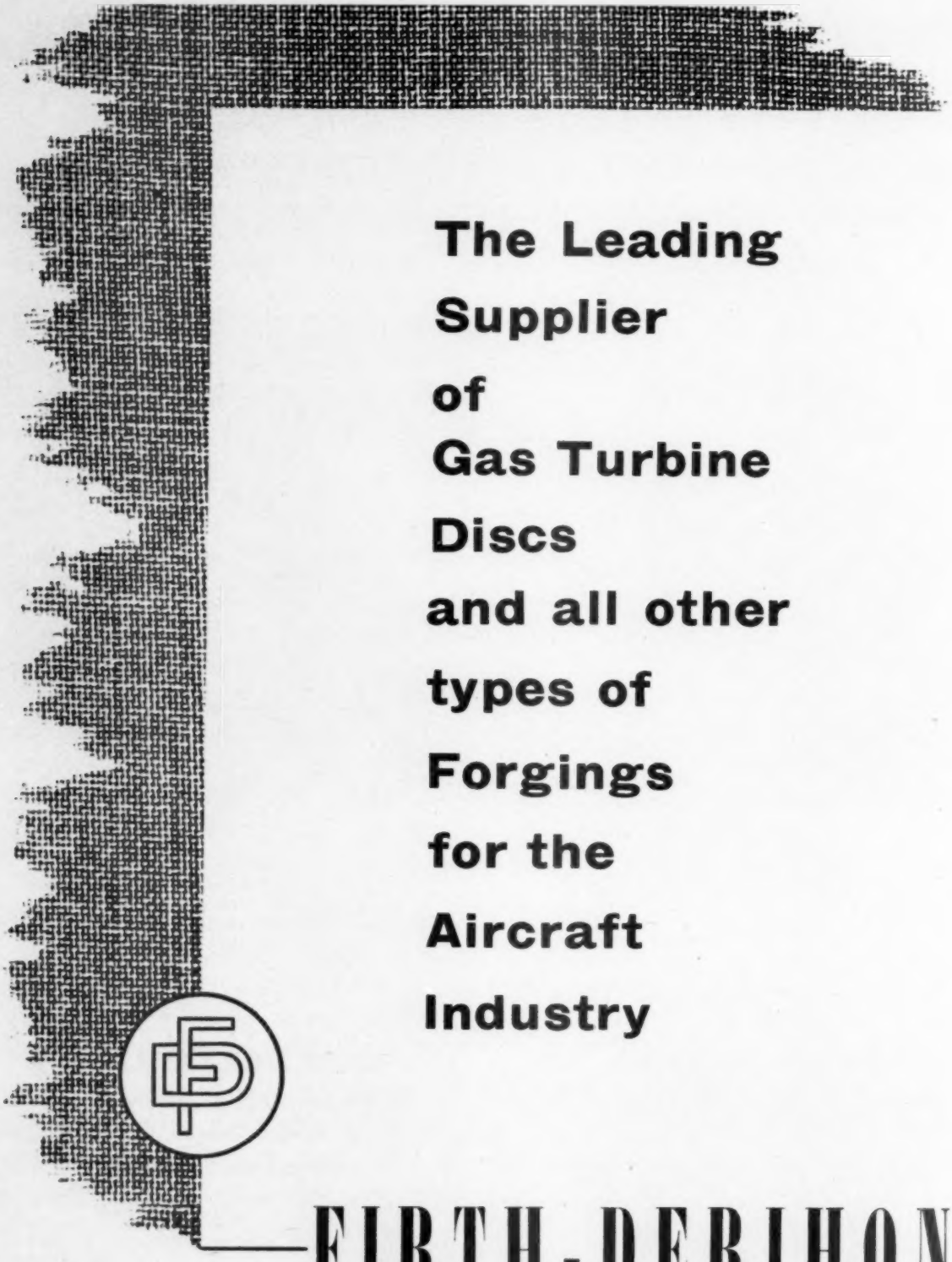

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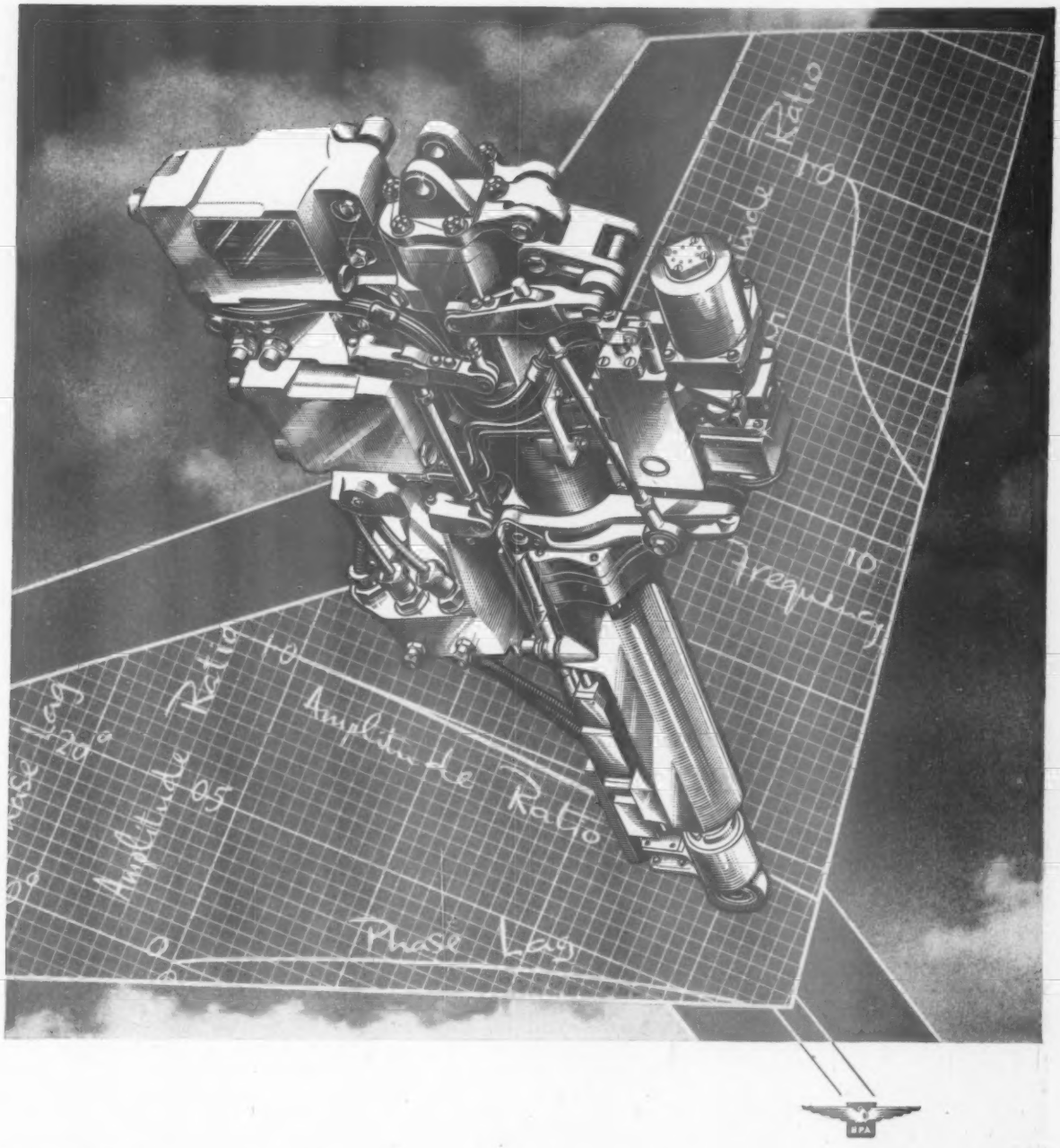

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Boulton Paul powered flying control units incorporate rotary control valves, designed for sensitivity and accurate response. The tandem ram unit illustrated actuates the Blackburn NA.39 all-moving tail plane and operates in manual control, with or without auto-stabilization, or under complete auto-pilot authority.

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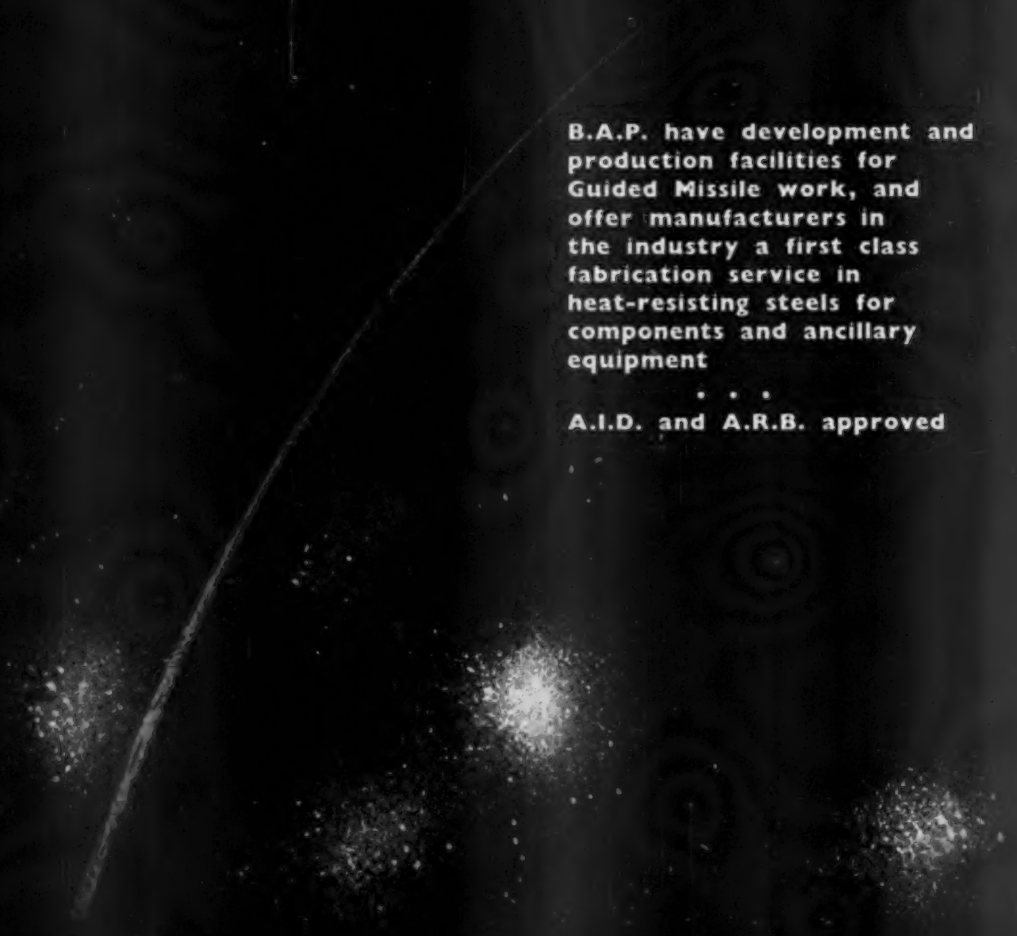

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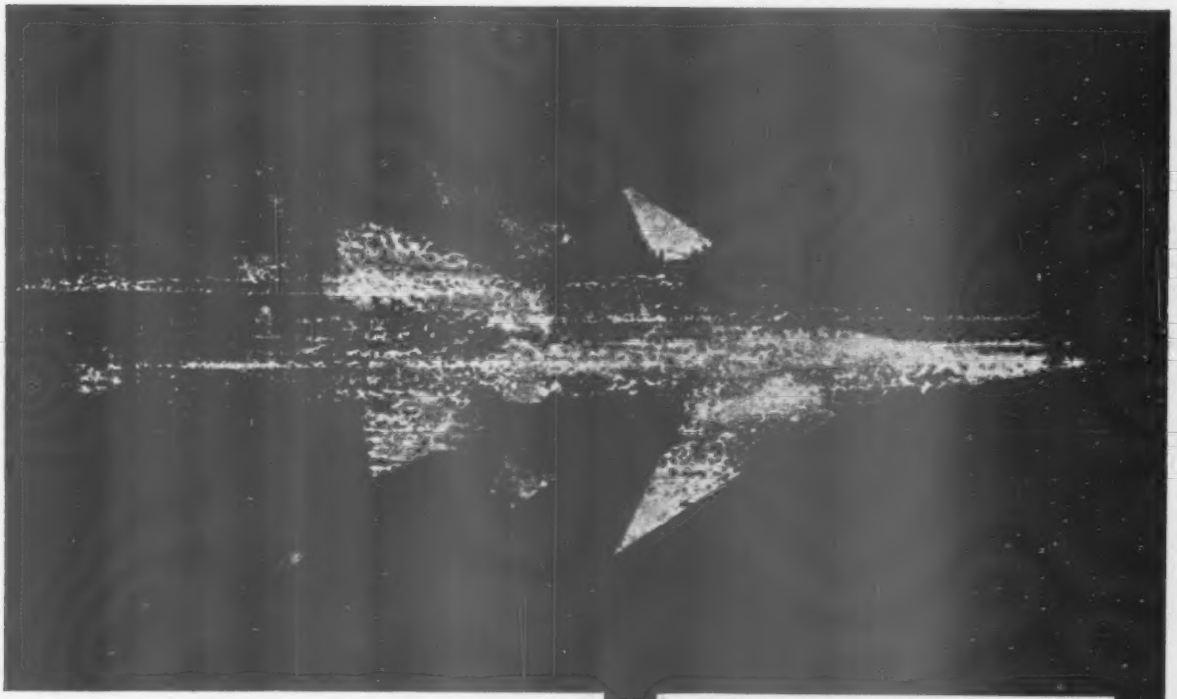

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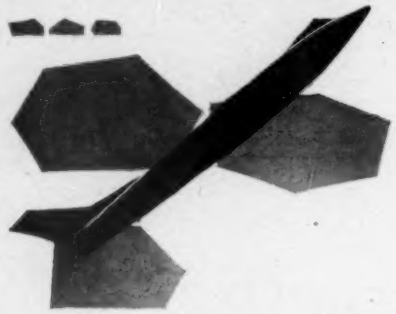

Dramatic weight-reduction in airborne search radar!

EKCO LIGHTWEIGHT SEARCH RADAR

Ekco, first in the world with commercial Airborne Search Radar, now announce yet another major Ekco advance in this field—EKCO Lightweight Search Radar.

This new equipment reduces the total weight to only 56 lbs—less than half that of previous systems! Yet, Ekco Lightweight Search Radar provides all the facilities of a modern Weather Radar System, including a fully-stabilised 24" antenna, 150 mile range and high brightness display.

The reduction in size and number of units, made possible by the extensive use of transistors, allows a consequent saving in installation costs and mounting weight.

These three compact units make up the new Ekco Lightweight Search Radar:
1. Indicator
2. Scanner
3. Transmitter Receiver

SEE IT AT FARNBOROUGH
STAND No. 186/7
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Airfield Approach Aids Transistorised Inverters

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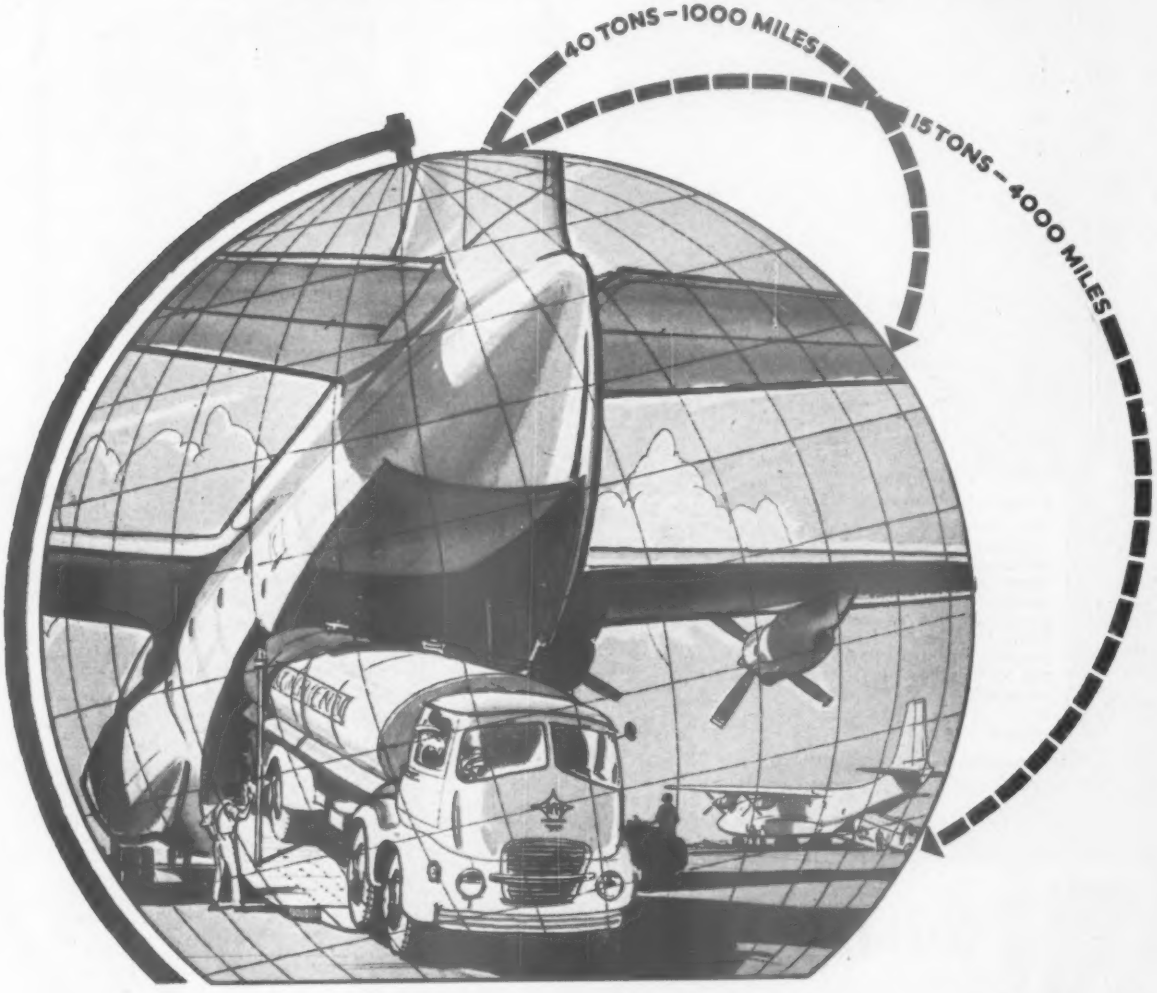

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Most versatile, most capacious transport aircraft in the world

Large missiles, armoured vehicles, radar installations ramp-loaded without crating, rushed distances up to 4,000 miles non-stop, then smoothly unloaded and *ready;* troop detachments, quickly embarked and as quickly in action. This is the strategic military role of the Short turboprop Britannic, designed to meet the vital needs of the future, *anywhere.*

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These qualities, plus the turboprop economy of the four Rolls-Royce Tyne R Ty.12 engines, make the Britannic a formidable contender for the air freight market of the future.

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SHORT BROTHERS & HARLAND LIMITED, QUEENS ISLAND, BELFAST, NORTHERN IRELAND *The first manufacturers of aircraft in the world*

Features:

Press button, 9-position, back-rest, Bungee operated quick return with forward emergency fall. Non-fume removable ashtray housed in centre arm, also recessed fittings for detachable light-weight meal tray. Meal tray stowage and magazine pocket with zipped openings in rear upholstery. Individual retractable 2-position footrests fitted to each seat place. Life belt stowage at front on either side.

Rear view of seat, for B.E.A., showing meal tray extended and as recessed into rear of seat when not in use. Note overall clean lines.

Features:

Press button, 4-position, back-rest with controlled forward emergency break. Removable ashtray housed in centre arm. Meal tray elegantly fitted and recessed into rear of squab when not in use. Capacious plastic net pocket, readily accessible. Life jackets neatly stowed in front at either side.

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These seats, of Magnesium alloy, argon-arc welded tubular construction, have been developed to de Havilland specification and can be upholstered, with Lancedown interiors, to suit any requirement. Those for Aerolineas are particularly pleasing, upholstered in Stellar Blue and Mushroom Lurex cloth with armrests in matching Skye Blue leather. Overall weight: forward version only with footrests, 63 lb. Those for B.E.A. feature clerical Grey cloth with contrasting Coral Synthede on the side panels and armrests in matching leather. Overall weight: forward version, approx. 62 lb., aft version approx. 67 lb.

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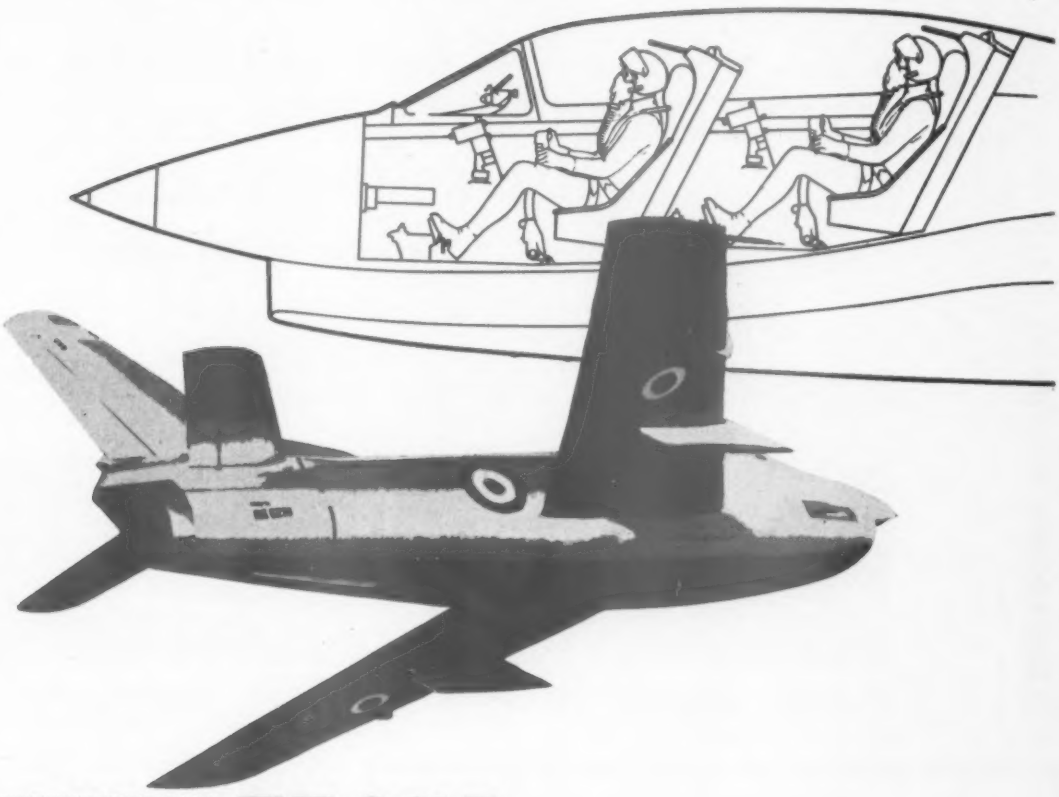
FIAT G 91 T



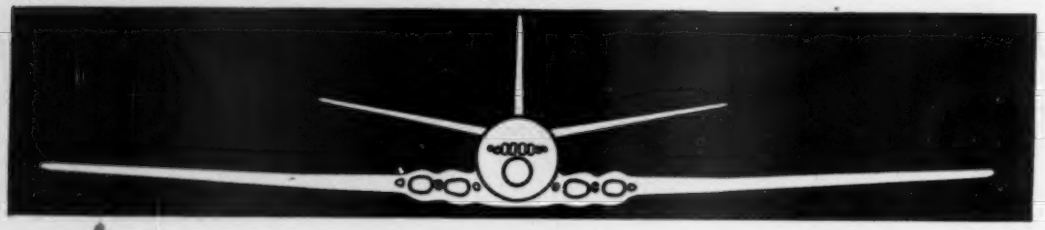
THE G 91 T
A NEW FIAT JET-TRAINER

(Bristol Orpheus 803 engine)

This Jet-Trainer is derived from the G 91 lightweight tactical fighter, winner of the NATO competition, and is expressly designed for advanced training up to supersonic speeds.

The ability to operate from short, semi-prepared or grass runways, the safety of evolutions performed at low speeds, the great responsiveness, the simplicity and low cost which are peculiar to the single seater version, are all to be found in the two-seater type.

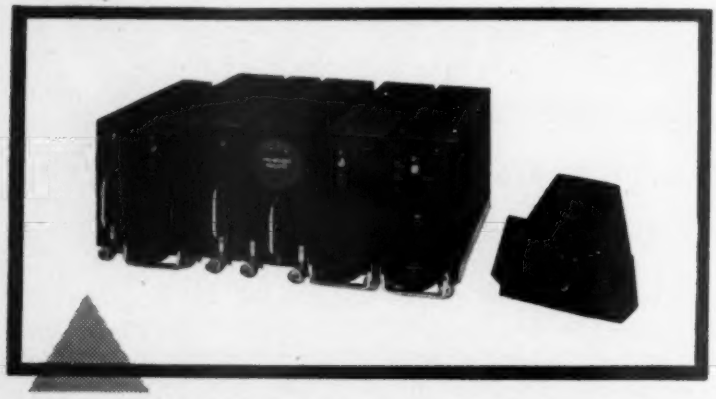
FIAT - AVIATION DIVISION
200, Corso Giovanni Agnelli - TURIN (Italy)



B.E.A. COMET IVB AND VANGUARD FLEETS ARE BEING EQUIPPED WITH STR 23/34/35/36 COMPREHENSIVE AIRBORNE VHF COMMUNICATION AND VOR/ILS NAVIGATION EQUIPMENT incorporating TRANSISTORS

FARNBOROUGH STANDS NO. 145-8

A new concept in airborne Radio Equipment



Approx. half the weight, half the size, and half the power consumption of equipment it replaces!

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SR.23 Receiver 560 channels, 50 kc/s channel spacing, in the band 108-135.95 Mc/s. All spurious responses at least 90 db down.

SR.34 V.O.R./I.L.S. Localiser Receiver. Comprises a Receiver and Instrument Drive Unit. The receiver is identical to and interchangeable with the SR.23. 100 channels, 100 kc/s channel spacing, in the band 108-117.9 Mc/s (50 kc/s spacing, incorporated and available when required).

SR.35 Glide Path Receiver. 20 channels in the band 329.3 to 335 Mc/s.

SR.36 75 Mc/s Marker Receiver. (Superheterodyne).

Operates from 115 volts. 400 c/s, single phase A.C. and 28 volts D.C.

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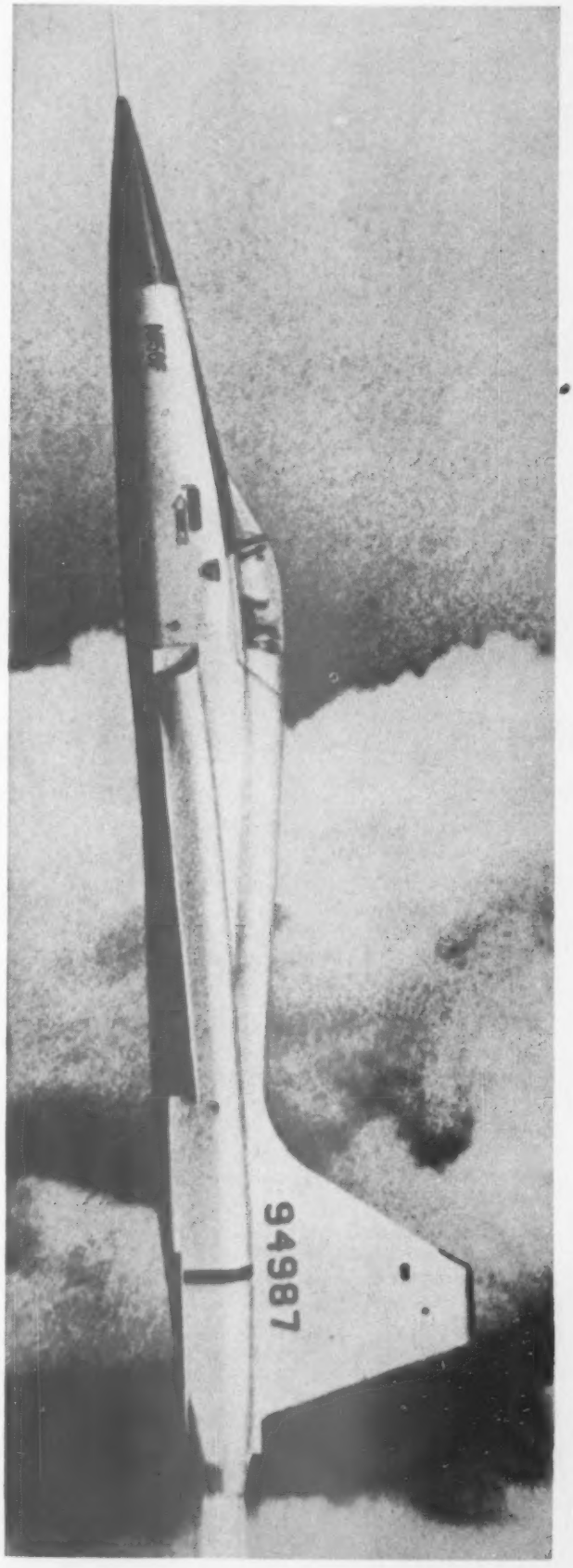
Northrop's N-156F is the first airplane U.S.-designed specifically for defense needs of the other Free World nations. The Freedom Fighter takes advantage of new jet engines, new lightweight materials, new design technology that no other fighter yet reflects. With its multi-purpose mission capability, performance, and ease of operation, the N-156F can virtually double a nation's effective fighting force.

This is because the Freedom Fighter is lighter, smaller, and easier to operate. Light, simple design cuts procurement costs, results in fuel savings and ease of maintenance. The Freedom Fighter cuts by approximately 50% the need for heavy, costly ground support and rare skills.

This highly reliable airplane can take off any time – almost anywhere – scant seconds from the scene of possible air or ground combat. This mobility contributes to quicker reactions. It keeps more aircraft battle-ready along a wider and more dispersed perimeter for maximum striking power – with minimum vulnerability. As a multi-purpose fighter, the N-156F flies air-to-air, air-to-ground, and low-altitude strike and reconnaissance missions.

No weapon system today matches the Freedom Fighter's advantages. It costs less to buy, to fly and to maintain. And because the N-156F is designed for production outside the United States, this new fighter will contribute to the economies of the countries it will defend.

Test pilots use the word "clean" to describe the N-156F's performance. Their reports praise its low- and high-speed flight handling characteristics. They find the new fighter meets and exceeds all the performance indicated and assured by extensive wind tunnel tests. They appreciate its twin-jet safety – its all-weather dependability.



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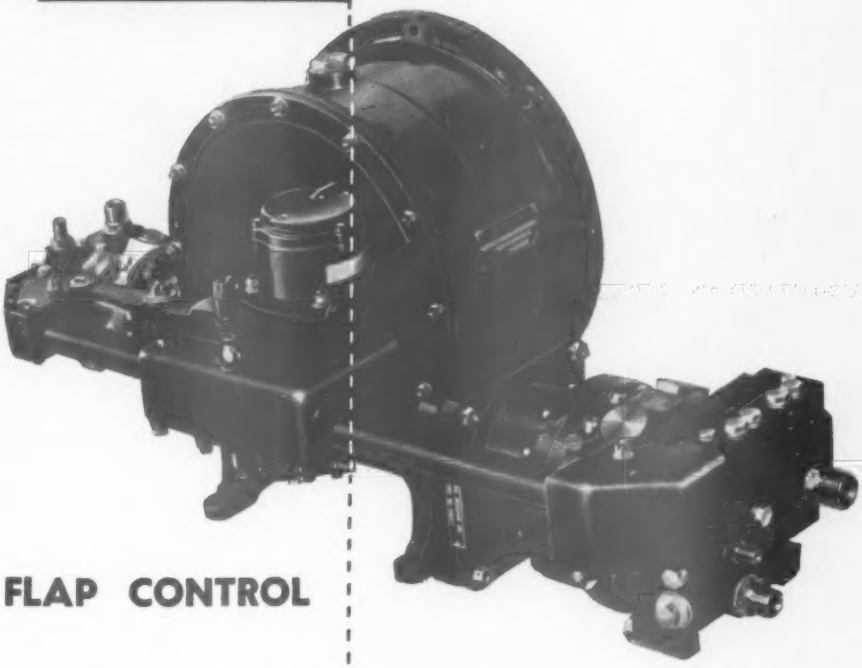

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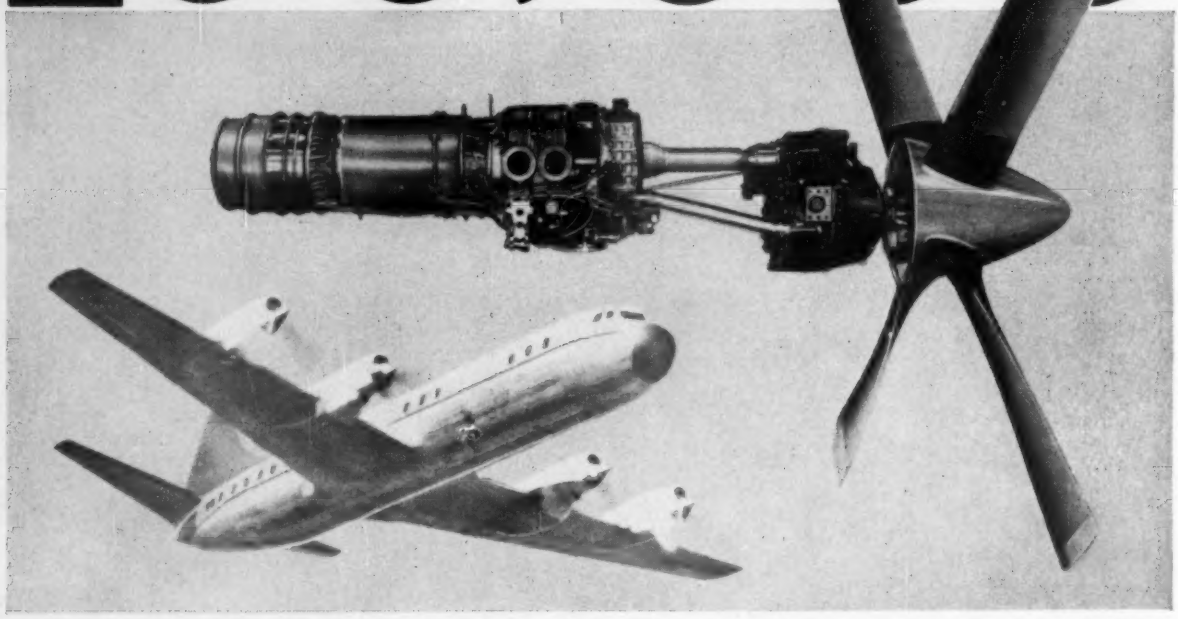

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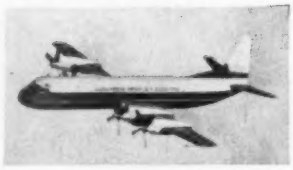

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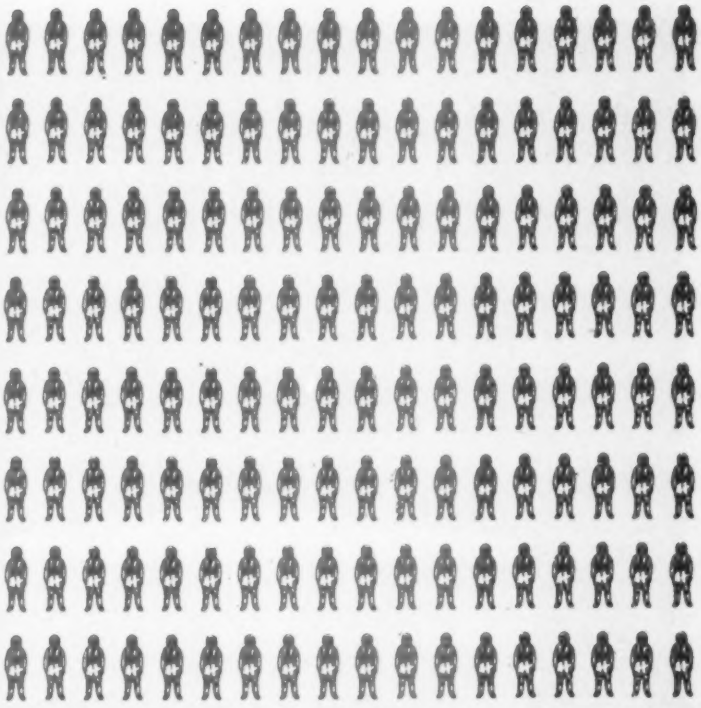

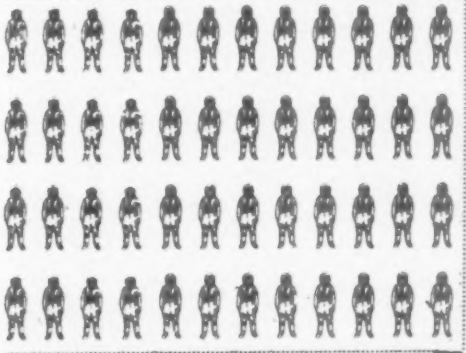

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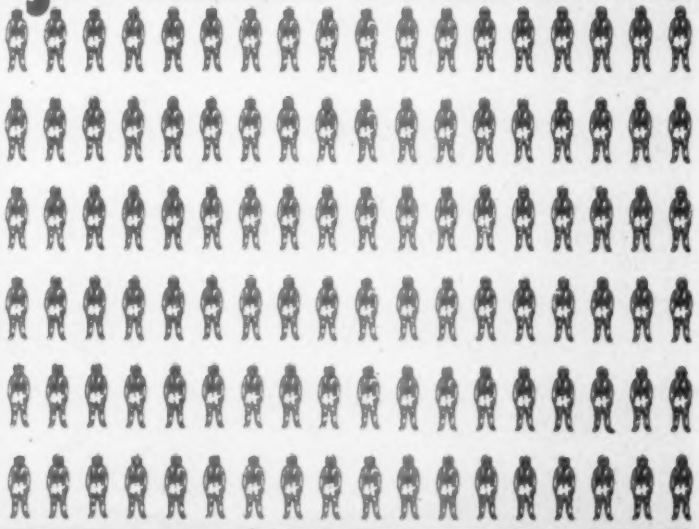

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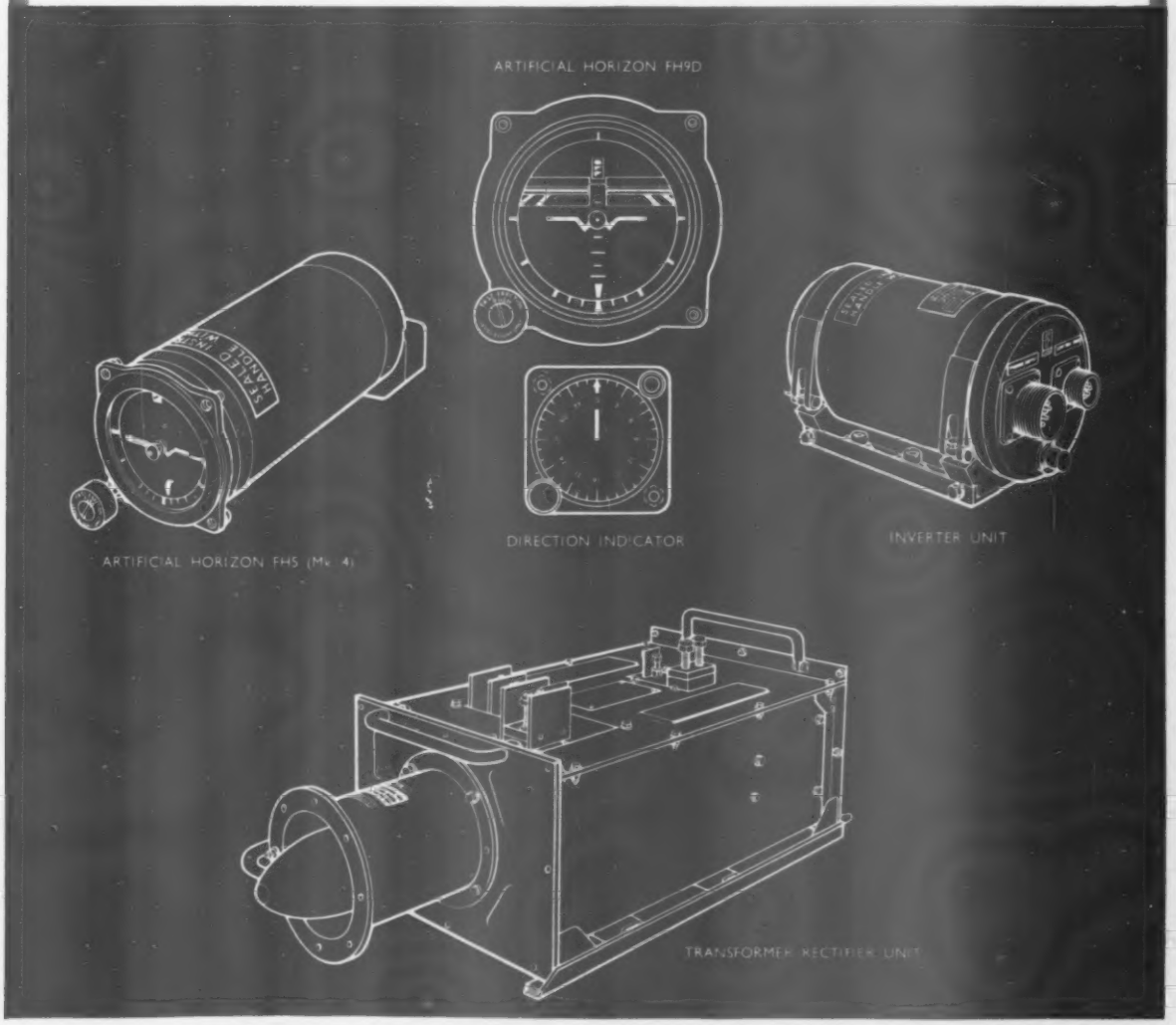

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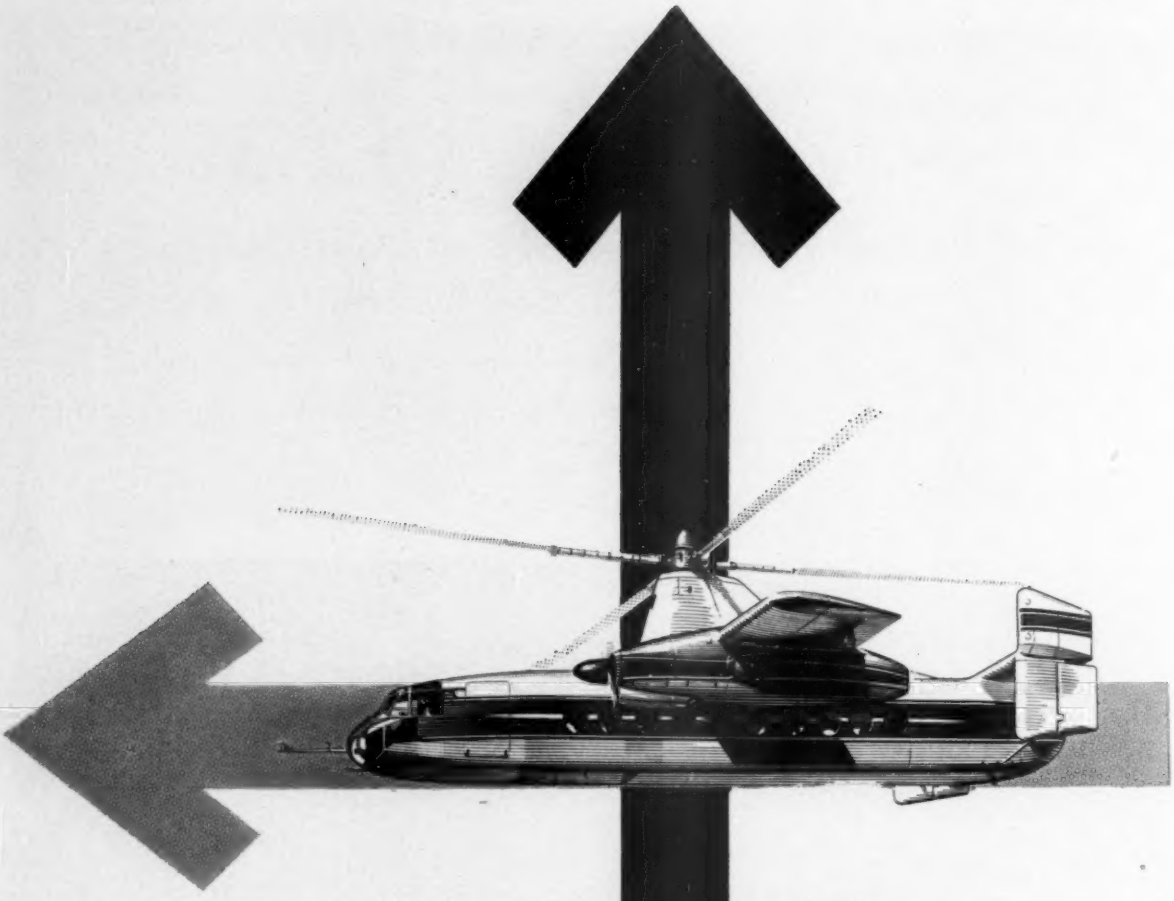

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THE AEROPLANE and ASTRONAUTICS

VOLUME 97 NUMBER 2499 SEPTEMBER 11, 1959

Black Knight's Gambit

Extremes of aeronautical effort are exemplified at Farnborough by the two-stage Black Knight rocket and the pneumatically supported Hovercraft. One at each end of the range shows in what widely separated fields the aeronautical engineer, and the industry in which he works, can make outstanding contributions. If the Hovercraft is unique by land (or sea), Black Knight is indeed notable among rockets for its record of successful firings. And the whole effort has cost the country perhaps £5,000,000.

If there are still those who remain unconvinced regarding the value of the British achievement with Black Knight let them study the speeches and addresses delivered before the 10th Congress of the International Astronautical Federation which concluded its deliberations on the eve of the S.B.A.C. Show.

At its opening session this congress had the good fortune to be addressed by Dr. Hugh Dryden, now deputy director of NASA, the great civilian agency which directs and guides aero/astronautical endeavour in the United States. Before this appointment Dr. Dryden was director of the U.S. National Advisory Committee for Aeronautics, the down-to-earth activities of which in research and development for practical aviation have long been admired in this country. Thus when a man concerned for so many years with the practical problems of developing aeroplanes as operational vehicles says unequivocally that the instrumental exploration of space having begun man will follow his apparatus in due course, the rest of us would do well to accept his views. Many will be encouraged to do this by Dr. Dryden's assertion that the problems of space exploration demand international collaboration. "There is every indication," he said, "that the task may soon develop beyond the resources of any single nation."

Time for a New Approach

Nevertheless, this must not be taken to mean that any one nation can relax and wait for international action. As Sir Roy Fedden said in his letter to the *Daily Telegraph* of September 3, the (British) aircraft industry does much more than make aircraft and missiles. It is a very highly disciplined form of engineering, and from it stem new ideas and developments in materials and machine-tools as well as auxiliary techniques covering a very wide field in mechanical, electrical and electronic technology. It is implicit from these remarks of Sir Roy that without an up-to-date healthy aircraft industry this country would be deprived of all that comes from a very highly disciplined form of engineering.

No one knows this better than the lively group of British engineers who made such a contribution and impact on this year's double astronautical conference. The problem that worries them is how is their work to be financed.

The present system of financing developed to meet the needs of the Fighting Services, has utterly broken down. Unfortunately this country has no civilian body such as the U.S. NASA. Consequently, unless a project (however imaginative and potentially rewarding) meets an existing Service requirement, the technical branches at the Ministry of Supply can obtain no sanction for expenditure from the

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Treasury. Some might hope that the time is not far off when the Air Staff will start planning a Space Force; others will feel it must be years away since we have hardly begun to arm ourselves with rockets yet. In this situation we doubt whether the Ministry of Aviation and Astronautics postulated by Sir Roy Fedden in his letter will help much.

The day has come, surely, for this country to work out a new approach to aeronautical development and astronautical research. It is about time that it should be accepted that just as far-sighted businesses plough back substantial portions of their earnings into research and development so should a great nation earmark a substantial portion of its national income for a similar purpose. As the standard of living rises so must expenditure on research. As living and leisure become more complicated so does the engineering which supports them.

The standard of living in the U.K. has done very well during the years when there has been substantial allocation of the national income to aeronautical research. Our suggestion that from now on it is to be charged to a new account instead of defence cannot depress the standard of living. For the reasons that Sir Roy adduces it will contribute to raise it.

Moreover, the resultant products will keep the aircraft factories going. And a substantial proportion of the working population is interested in just such a thing.

Finally, the allocation of the money to be ploughed back in research must be planned by a competent and expert body independent of, but advising, the Government. Such planning should be in fact the basic job of that Air and Space Board for which some of us have been asking so long.

Matters of Moment

The Spin—Who Recovered First?

AN important letter in the *Sunday Times* for August 30 should do much to establish the primacy of Lieut. Wilfred Parke, R.N., as the first British pilot to recover from an unintentional spin which he did on August 25, 1912. The writer of the letter, Constance Babington Smith, well known for her book "Evidence in Camera" and her pre-War column in THE AEROPLANE as it then was, speaks with authority since she has accumulated much data for her forthcoming book on British test flying.

It would be specially interesting to learn of Continental experience in this matter because, as is British custom, we were pretty slow in getting going in this flying business and so it is likely that this catastrophic phenomenon had been encountered earlier. Perhaps readers in France or elsewhere on the Continent have some information on this subject.

Absent for a Purpose

NO doubt there will be considerable speculation about the reasons behind the absence from the S.B.A.C. Show of exhibits by the Miles Group. We are assured that there is no question of this vigorous concern giving up the race. The directors have felt for some time that the S.B.A.C. Show instead of being an annual event should be run alternately with the International Air Show in Paris. This is a point of view in which they are not alone, as is well known.

Having gone to considerable expense to exhibit at the Paris Show the directors decided not to exhibit at all at Farnborough this year because it was felt that the burden of taking part in two important shows in one year (and only three months apart) was too great for small firms. The Miles Board points out that participation in these very expensive shows must inevitably be at the expense of development work. They prefer to forgo the former and continue with their endeavours to produce P.V. prototypes—two of which have been built in the past three years. Their decision, as they say, is a private-venture attempt to increase development work.

We must observe that, unfortunately, it is no longer possible to discuss the advantages of making the Farnborough Show alternate with an International Show in Paris. The Germans have now announced their intention of having an International Air Show at Hanover next May. One must also expect to see invitations being issued to participate in Air Shows in the Communist countries. And across the Atlantic the Americans have now inaugurated their International Air Show at Las Vegas.

It will be interesting to see whether the characteristically individual lead taken by F. G. Miles, Ltd., will have any repercussions; the increasing number of International Air Shows undoubtedly complicates the situation.

Air Marshal S. Mukerjee, Chief of Air Staff, I.A.F. (centre) at the reception given in his honour in London on Sept. 1 by the Air Adviser to the High Commissioner for India, Gp. Capt. H. Moolgavkar, and by Mrs. Moolgavkar (left). Sir Frederick Handley Page (right), Lord Lieutenant of Middlesex, greeted President Eisenhower on his recent arrival at L.A.P.

BE.58 Details

PERFORMANCE DETAILS of their significant new ducted-fan engine, the BE.58, have now been released by Bristol Siddeley Engines. This is the second engine to be announced in the company's ducted-fan range; the first was the BE.53 "lift-thrust" engine which is probably being developed under M.W.D.P. auspices for the Hawker P.1127 VTOL fighter.

The BE.58 is an engine for civil or military transports; it develops 14,500 lb. thrust for take-off at an s.f.c. of 0.572 lb./lb./hr. and weighs only 2,600 lb. Its thrust-to-weight ratio is thus no less than 5.58 : 1. Its cruise consumption at 36,000 ft. and 600 m.p.h. is 0.8 lb./lb./hr. It is a front-fan engine with a by-pass ratio greater than 1.5 : 1. Many of its components are derived from those of the Olympus and Orpheus.

F. H. Parker

WITH deep regret we record the death, on August 30 after a short illness, of Mr. F. H. Parker, A.F.R.Ae.S., engineering manager of Fairey Aviation, Ltd. Born in Bristol in 1913, he served an apprenticeship with the Bristol Aeroplane Co., after which he entered the company's drawing office and later transferred to the production side of the organization.

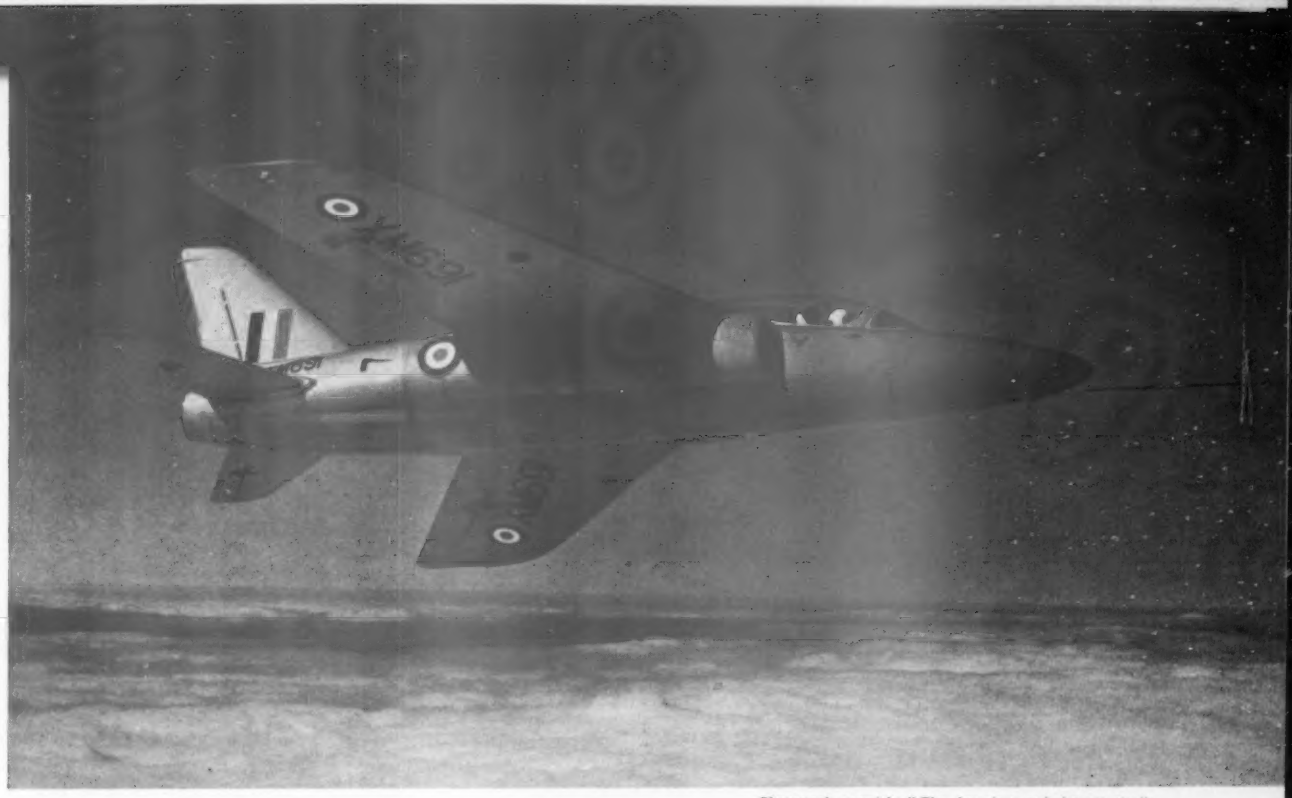
Mr. Parker was appointed Bristol's chief planning and production engineer in 1941; and in 1947 he became deputy chief development engineer. He was closely concerned with the production of Bristol Beaufighters, Brigands and Freighters and the development of the Britannia and early Bristol helicopters.

He joined Fairey in 1951 as assistant chief engineer and six months later was appointed engineering manager. In these posts he was responsible for the engineering of such aircraft as the Gannet prototype, the Gannet AEW.3, the Fairey Delta and the Rotodyne. His cheerful presence and enthusiasm for the task in hand will be sadly missed by his many friends throughout the industry.

R.A.F. Transport Order

A CONTRACT for 20 Armstrong Whitworth 660 tactical freighters for use by Transport Command has been placed by the Ministry of Supply with Hawker Siddeley Aviation. At an approximate price of about £500,000 per aircraft, the contract is worth some £10 million.

This order for the A.W.660, a military version of the A.W.650 Argosy Freightercoach which first flew on January 8,



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GNAT FOR TWO.—First air-to-air view of the new Folland Gnat Trainer, taken at Chilbolton on the day of its maiden flight—September 1. The Orpheus-powered two-seat Gnat is one of the newcomers at the S.B.A.C. Show.

1959, was forecast by the Minister of Supply in a Parliamentary reply on January 26, 1959. It can also be regarded as the start of what is likely to be a substantial requirement for the R.A.F. as older types of transports now in service are replaced.

Powered by four Rolls-Royce Dart turboprops, the A.W.660 will have a gross weight of approximately 100,000 lb., compared with 82,000 lb. for the Argosy, and is reported to be capable of carrying a payload of 28,000 lb. for 800 n. miles or one of 15,000 lb. for 1,900 n. miles. As a troop transport it will carry up to about 70 personnel cruising at around 290 m.p.h.

It has a "beaver tail" rear door which can be opened in flight for supply dropping of vehicles, equipment or guns. On the ground the lower half of the tail opens to form an integral loading ramp. The A.W.660 is to be equipped for in-flight refuelling, presumably for ferrying operations.

Medical Aspects of Space Flight

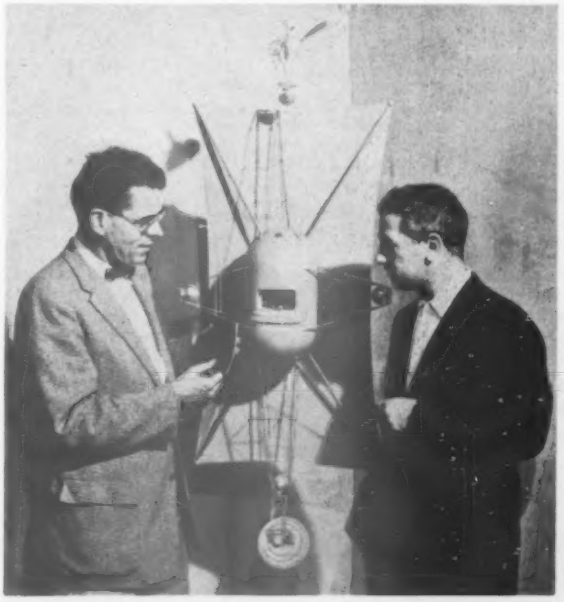
SPACE simulation and "space simulators," for selecting and training space crews, were not heard of at the last London I.A.F. Congress in 1951, but at the Tenth Congress rather suddenly and urgently jumped to the fore. Brigadier-General D. F. Flickinger, of Research and Development Command, U.S.A.F., described the procedures by which 220 candidates for Mercury Project were finally reduced to seven. An unexpected finding was that skin-diving practice helped them not only to improve their breathing technique in closed respiratory systems, but to cope with disorientation.

After J. Gordon Vaeth, understood to be a veteran balloonist, had recommended stratosphere balloons as useful "simulators," Col. G. R. Steinkamp and colleagues described what happened to five "subjects" who were shut in a simulated space cabin for seven days, during which they could not stand erect but had alternate four-hour periods of work and rest. A signal told them what work to do. Comforting background noise was provided by an air blower, and they had a few gramophone records for adding to it. Psychologically the experiment was successful, except for one subject who got a bit panicky on realizing he did not know how long he had been there—until he counted his empty food containers and found out.

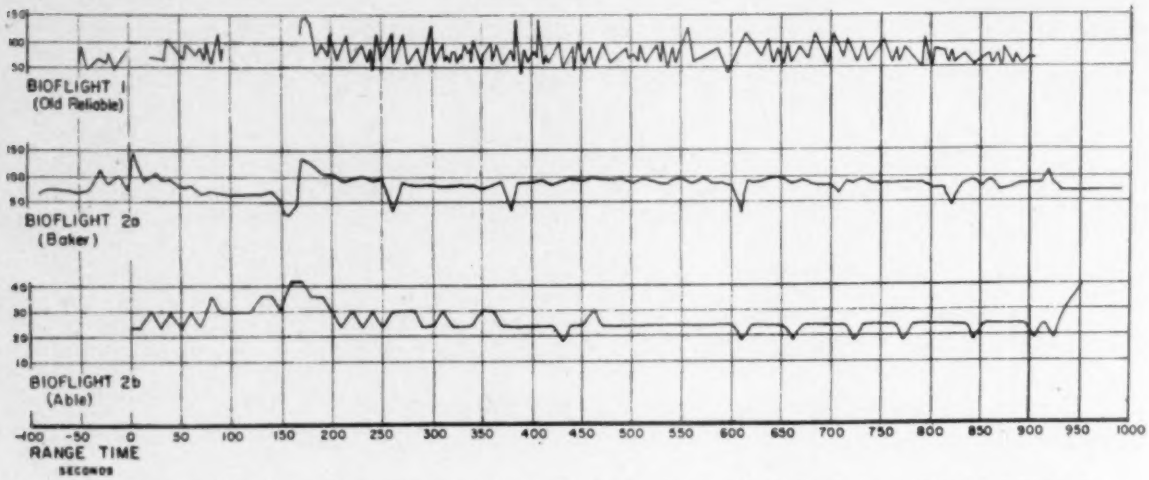
The cabin air in Steinkamp's experiment was renewed and purified chemically. We had no papers this time on the experiments already done in the U.S.—at least with animals—on the alternative of a "closed system" using plants to supply oxygen and food and absorb the carbon dioxide. But F. Violette and colleagues from the Aviation Medicine Centre in Paris claimed that this cycle would not work beyond a limited period, because essential nitrogen, sulphur and phosphorus would be slowly eliminated from the closed circulation, never to be reabsorbed. Yet the system seems to work on the Earth as a whole, which does not need to import these substances to keep its life going.

Then we had Mr. T. C. Helvey, of the Radiation Biophysics Dept. in Kansas University, an amazing character whose non-stop ideas for experiments far outrun his resources for setting them up, though he hopes to carry them all through some day. This time it was a life-on-the-Moon simulator, a huge airtight building with an internal atmosphere equivalent to that at 35,000 ft., to minimize the danger from explosive decompression.

Inside this simulator he would place two men and a woman, to test his theory that they would form the ideal combination



SPACE PROBE.—This Boeing model is of a manned Counter-Moon space probe for use "after a research colony is established on the Moon."



Respiration rates (breaths per minute) recorded during Jupiter flights show how both the monkeys "Able" and "Baker" responded to cut-off (between 150 and 200 sec.). Only "Able" reacted to re-entry (between 900 and 950 sec.).

for a space crew of three. Anyone taken ill, or who could not stand it any longer, would (unless his life was in immediate danger) not be taken out for another four days, as it would take that long to get him home from the Moon. Imitation meteorites would be shot through the roof at vital equipment to find out what spares would be needed. And so on.

Needless to say, when the space medicine experts decided to hold an informal discussion on the Wednesday afternoon, Dr. Helvey pretty well dominated the scene. Stimulated, no doubt, by Dr. H. Strughold's paper on "the human eye in space," in which he warned that the sun would look dazzling even from beyond the orbit of Saturn, the meeting started by discussing vision in a space cabin.

Dr. Helvey had set a team to work out a suitable window for the cabin, with the result that they recommended no window at all, for it would be dangerous both structurally and for letting in light which would damage the occupants' eyes. But when he proposed a television screen to serve the same purpose, one medical man protested that there was no point in travelling through space if one could not admire the glorious view.

As to the "closed cycle" idea, Dr. Helvey asserted that the food problem has not yet been solved, for even algae with added beefsteak flavouring would pall after three months. But the watercycle, one speaker revealed, was solved 15 years ago by German troops in Africa, who for two months drank only purified water recovered from human excretions.

Several speakers at this discussion declared that it was impossible to sterilize a space ship to avoid contaminating other worlds with earthly life. This was to some degree confirmed by a later paper by R. W. Davies and M. G. Comuntzis, of California Institute of Technology, who had a NASA contract to examine the question. After recommending ethylene oxide as the main sterilizer, they asserted that absolute sterilization is impossible, however thoroughly carried out. All we can do is to decide, for instance, on a degree of thoroughness which will reduce the chance of infecting Mars or Venus to less than one in a million, as the authors recommend, or to one in 10 or 100 for the Moon, which is probably less susceptible to infection.

The risk of infecting Mars is shown by the experiments of I. Davis and J. D. Fulton, of the U.S.A.F. School of Aviation Medicine, who succeeded in growing two strains of bacteria in "Mars jars" containing imitation Martian desert soil in an imitation Martian atmosphere of pure nitrogen.

From Warsaw came a paper by O. Wolczek pointing out that weightlessness could be produced for experimental trials by using a centrifuge revolving in a vertical plane, though the weightless periods would, of course, alternate with periods of excessive *g*, even if, as he suggested, the "capsule" was repeatedly tossed across between two parallel centrifuges revolving in opposite directions. Dr. H. J. von Beckh described a capsule in which, if subjected to excessive *g*, the occupant always swings so that the force acts transversely to his head-to-foot axis.

R. P. Haviland, of General Electric, described in detail his proposed satellite designed specially for biological research.

Ashton Graybiel, of the U.S. Navy, and his colleagues, who launched monkeys into space, revealed unexpectedly that the most anxious period of the experiments was that of seven hours which the animals spent cooped up in the nose cone before being launched; one monkey died during this stage.—A.E.S.

Running Blue Streak Engines

ROLLS-ROYCE confirm that test firings have begun of a large rocket engine associated with the Blue Streak LRBM programme. The tests are being made at the Spadeadam test establishment in Cumberland which Rolls-Royce manage on behalf of the Ministry of Supply. It can be assumed that the engines tested are the actual ones to be used in Blue Streak; this marks a significant step towards the first launchings of this missile which are expected at Woomera next year.

Atlas—Sixth Time Lucky

ON the brink of becoming operational, July was the date originally planned, the Atlas ICBM failed on five consecutive firings over the Atlantic range, and test launchings were subsequently suspended. In mid-June, an Atlas on static test caught fire and exploded. When test launching was resumed at Cape Canaveral on July 16, the first attempt was abandoned only four seconds before take-off because the missile developed insufficient thrust. A second launching attempt the same day was also called off before the missile left the ground.

Finally, on July 21, a successful firing was made over a range of 5,500 miles, the "dunce cap" nose-cone descending in the prescribed target area near the Ascension Islands in the South Atlantic. According to the U.S.A.F., this was the first time that a "full-scale" Atlas nose-cone had been recovered over the full design range.

A further announcement on July 29 that another Atlas had been successfully fired over 5,000 miles undoubtedly did much to restore confidence in the wayward missile. The U.S.A.F. explained that various modifications had now been incorporated, but not all the failures that occurred between February 20 and June 6 were directly attributable to the missile.

Two resulted from ground errors; a third was due to a guidance system error, which cut off the two booster engines 30 sec. too early, and the other two failures appeared to have been the result of severe fuel leaks in flight. The principal modifications, therefore, were concerned with the guidance system and the propellent supply to the engines.

German Air Board Visits Martin-Baker

THURSDAY, August 27, marked the high-spot of a visit to the Martin-Baker Aircraft Co., Ltd., by an Approval Board of the German Ministry of Defence. The Board—consisting of Herr Kircher, Ministry of Defence, Technical Department; Herr Heins, German Research Establishment for Aeronautics; Herr Ruck, Ministry of Defence, Aircraft Approval Department; and Herr Polte, Ministry of Supply—were at Denham to appraise the Martin-Baker Mk. GW5 ejection seat installation in their Canadair Sabre 6 aircraft. German regulations require that any major modification to an aircraft is approved by the Board before it is flown by the German Air Force.

Accompanying the Board were Col. von Ploetz, German Air Attaché; Lt.-Col. Werner and Capt. Flade of the German Air Force; Dr. Sedlmayr and Herr Bullwinkel of Autoflug; and Mr. D. J. MacDonell, Canadair representative with the German Air Force.

German interest in the Martin-Baker ejection seat has stemmed from the high fatality rates experienced with American types of aircraft during low-level ejections. Accordingly, consideration was given to the replacement of the existing ejection seats with the Martin-Baker fully automatic seats whose runway capabilities were successfully demonstrated by Herr Bullwinkel at Hanover Airport on May 5, 1958.

Similar to the Mk. R5 seat fitted to the North American F-86F Sabres of the Royal Norwegian Air Force, the Mk. GW5 incorporates all the latest features of the Mk. 5 series seats and is fitted with a Martin patent personal equipment connector on the port side of the seat pan. Not interconnected with the harness and leg line release mechanism as is the normal practice, the man portion of the P.E.C. is released on separation from the seat by a lanyard attached to the occupant's Mae West, a leg line release lever being provided for manual release of the leg lines. The aircraft canopy jettison system has been disconnected as ejection through the closed hood has been adopted as standard practice in an emergency.

The party of German officials arrived in this country on August 25 and spent the following day at the Martin-Baker factory at Denham discussing various aspects of the seat. On August 27 they visited the company's airfield at Chalgrove to examine the installation in a Sabre 6 of the German Air Force which had been delivered for modification some weeks previously, together with a Lockheed T-33 (Martin-Baker Mk. GU5/1 and 2 seats).

In the afternoon dummy ground-level and high-speed demonstration ejections were made from a Meteor piloted by Sqn. Ldr. J. S. Fifield, D.F.C., A.F.C., the company's test pilot. On the last day of the Approval Board's visit, the morning was spent at Chalgrove where the Sabre 6 was flight tested by Capt. Flade and the afternoon at Denham where discussions took place on the installation of the Mk. GQ5 seat in the Lockheed F-104 Starfighters of the German Air Force.

Mr. James Martin, C.B.E., M.I.Mech.E., F.R.Ae.S., managing director and chief designer of the Martin-Baker Aircaft Co., Ltd., handing over the release notes and log cards to the German Approval Board.

Minister Opens New Ferranti Laboratory

A NEW £150,000 extension has been built by Ferranti, Ltd., to the existing laboratory at its Crewe Toll establishment, Edinburgh. Opened by Mr. Aubrey Jones, Minister of Supply, on September 2, this new single-storey building is to be used for the manufacture of floated gyroscopes and gyro accelerometers, the basic components of inertial guidance navigation systems for aircraft, missiles, submarines and space vehicles.

The company has been producing these instruments for the past 1½ years in the existing factory at Edinburgh, but the new extension will provide a completely integrated development and manufacturing unit. Built with financial aid from M.o.S., the building will give Ferranti an additional floor area of approximately 17,400 sq. ft. for what is one of the highest forms of precision engineering.

Basically, the building comprises two sections. One is a relatively "dirty" area which houses two machine shops, in one of which there is no control of temperature, and a process department containing a variety of furnaces for heat treatment, special brazing and welding techniques, plating baths and so on. The other section consists of a "clean" area in which the temperature and humidity are carefully controlled and all dusty particles greater than about 0.5 micron are excluded. The dry-bulb temperature in the area is maintained at 72° F., ±1° F., and the relative humidity does not exceed 45%.

Containing the necessary equipment for the assembly, inspection and testing of these extremely low drift-rate gyroscopes, the clean area has a number of interesting features. The personnel working in the area will go through three stages of changing and dressing in specially provided nylon clothes, and pass through two blowing rooms before entering. Components from the machine shops will also pass through two double air locks and undergo ultrasonic cleaning before assembly.

To isolate the test area from ground-transmitted vibrations, two 40-ton and one 66-ton reinforced-concrete blocks are located on special mountings in a pit underneath the main floor. By use of the blocks and their associated pillars and tables, gyroscopes can be tested where they are not subjected to rotations greater than 1 sec. of arc/hr. or movements with accelerations greater than 0.0001 *g*.

Initially, the company's work is to be concentrated on the development and manufacture of components only, but at a later date Ferranti expect to extend its scope to include the production of complete inertial navigation systems. The majority of the present work is concentrated on the production of the Kearfott single-axis floated rate integrating gyro, manufactured under licence from the Kearfott Co., New Jersey, and a pendulous integrating gyro accelerometer, which has been developed at Edinburgh.

The design of all these instruments produced by Ferranti is based on the fluid support system evolved in the United States. This method of support is estimated to provide gyroscopes with random errors of less than 0.05°/hr., although this figure clearly depends on the system of measurement and the conditions under which it was obtained.

Technicians wearing special nylon clothing in the test section of the new Ferranti inertial guidance component laboratory at its Crewe Toll establishment at Edinburgh. A gyro is seen fitted in a test rig mounted on a vibration-proof table.

Air Transport

Helicopter Opportunity?

ONE of the many interesting and controversial points which came up in the evidence given in the Select Committee's Report on the Air Corporations (see the issue of September 4, pp. 88-89) concerned the possibilities of using helicopters on B.E.A.'s Land's End-Scilly Islands service.

The suggestion made was a practical (if, perhaps, mildly unethical) one to the effect that the M.T.C.A. might save about £30,000 per annum if the aerodromes at St. Just and St. Mary's were closed and that this sum would go a long way towards making a helicopter operation over the route a profitable one. "They [The Ministry] would be no worse off and we [B.E.A.] would be better off."

Obviously the primary value of such a helicopter service would be in terms of operational development. Suitable twin-engined helicopters could thus be used on a scheduled service and a great deal of work done on navigational methods, approach aids and lighting systems in preparation for more intensive operations in the future from city-centre to city-centre.

From the point of view of the travelling public there would be the considerable advantage that the service could be flown more or less from the railhead at Penzance instead of a rather out-of-the-way point near Land's End. The seven-seat D.H. 89 Rapides at present used are, no doubt, satisfactory enough in their way, but larger-capacity vehicles could certainly be filled and the public would undoubtedly prefer the idea of going by helicopter.

Eventually, sooner rather than later, the Rapides—which have been written down to zero, but for which Check 4 costs are inevitably high—must be retired and replaced either by STOL aircraft or helicopters if this valuable little short-haul service is to continue. Either way, this essentially seasonal operation—which just about pays its way with Rapides—will in future be an expensive one and the cost, if it must be incurred, might well be written off against really useful development experience.

Certificate for the DC-8

ONE month ahead of target date, the Douglas DC-8 Jetliner was granted an F.A.A. type certificate on August 31. The certification programme has thus been completed in exactly 15 months from the first flight on May 30, 1958, and has taken some two months less than scheduled, as the first flight was about five weeks late. In 15 months, test DC-8s have logged a total of 2,284 hours in 1,782 flights, including 1,302 hr. of instrumented test flying.

The version of the DC-8 certificated is the basic domestic model with JT-3C-6 engines. Later models, dimensionally similar, will have JT-4A-3 or Conway engines, more fuel and higher gross weights, up to a present maximum of 310,000 lb. In the course of flight testing, Douglas have developed leading edge slots for the DC-8, which are fitted in two sections—80 in. and 32 in. long, respectively—to each inboard wing section. Another modification applied to production DC-8s is a 16-in. extension to each wing tip, together with a change of shape.

A DC-8 was seen at London Airport for the first time last Friday, September 4, when N8068C, the seventh DC-8 built, made a transit stop en route to Amsterdam. This JT-4A-powered model is to be used by KLM for crew training and crew familiarization pending deliveries of their own aircraft. United Airlines plans to start service with the DC-8 on September 18, on routes from New York to San Francisco and Atlanta.

Heavier Britannia

BRISTOL AIRCRAFT have announced a 5,000-lb. increase in the allowable gross weight of all long-range variants of the Britannia. No structural modifications are involved and the new weight is applicable to Britannias in service with B.O.A.C., C.P.A., El Al, Hunting-Clan and Cubana. Associated with the increase, from 180,000 lb. to 185,000 lb., are a new max. landing weight of 137,000 lb. and zero fuel weight of 128,000 lb.—increases, respectively, of 2,000 lb. and 5,000 lb.

The increases represent a gain in the range with maximum payload, and in the payload which can be carried over greater ranges. There is no increase in maximum range.

Towards an ATC Millennium

AMONG 10 contracts recently awarded by the U.S. Federal Aviation Agency for research into air traffic control and air safety problems, three are of special interest. These are for visual collision-avoidance methods, for a "minimum air navigation system" and for air-traffic simulators.

The first, awarded to the Applied Psychology Corporation, involves the study and analysis of exterior aircraft lighting, painting and marking, and of real or artificial smoke and vapour trails. The research will include flight testing of collision-avoidance systems.

The "minimum air navigation system" is to be developed by Lear, the concept being an airborne computer which will automatically correct DR navigation instruments by means of signals from a VOR or Vortac station. Such a system would permit aircraft to fly off airways.

Stromberg-Carlson are developing the traffic simulation system which will be designed as a laboratory for the examination of new ATC techniques and optimum procedures for different airports and local airway patterns.

In addition to these, the F.A.A. has also awarded a contract to the National Aeronautical Corporation (Narco) for the development of low-cost, low-weight DME equipment for executive aircraft and the delivery of 20 suitable airborne units by September, 1960. These units will operate on Vortac installations, some 40 of which should now be in use in North America.

ON TEST.—An unusual and attractive air-to-air view of a Comet 4—actually the 17th of 19 B.O.A.C. Mk. 4s (G-APDR/DT) on the British Register. A Comet 4B for B.E.A. is being shown this week at Farnborough.

FIRST FOR K.L.M.—This Lockheed Electra is the first of the L-188C international variants due to be delivered to K.L.M., which has 12 on order. As recorded last week (p. 86) K.L.M. now has an entirely new styling for its fleet and this Electra is the first aircraft to be seen in the revised livery.

The Decca Airway

AS already recorded (issue of August 28, p. 78) a new climb-out airway (Amber One Decca) has been introduced for a trial period of six months from September 1. This airway—to the west of Amber One and between the London terminal control area and Red Three—is for the use of turbojet and turboprop aircraft using the Decca Mk. 10 receivers and Flight Logs. Its institution is a natural development of the U.K. policy in the matter of short-range navigational aids.

Aircraft leave Amber One at 52° N, after being routed via the Beacon Hill or Woburn fan markers, and fly over the Birmingham control zone (11,000 ft. upper limit) and on a track parallel to its south-west boundary before joining Red Three. The upper and lower limits of A1D are 7,000-20,000 ft. to the boundary of the Birmingham zone and 11,000-25,000 ft. thereafter. There are two designated and two on-request reporting points. Known traffic on the airway is separated by five minutes or more longitudinally and by 1,000 ft. vertically; control is the responsibility only of Southern (London) or Northern (Preston) A.T.C.C.; and all flights are monitored by radar (London A.T.C.C. and R.A.F. Hack Green).

JetStar Improvements

PRODUCTION models of the Lockheed JetStar executive transport will have several improvements compared with the two prototypes. Powered by four Pratt & Whitney JT-12 turbojets, the production JetStar will have thrust reversers; leading-edge flaps; dual-wheel main and nose undercarriage; additional overhead clear-vision panels in the cockpit; new landing lights; additional provision for de-icing and all-weather radar; and other detail changes.

The max. landing weight will be increased by 2,000 lb. to 28,000 lb. Max. range, with a 45-minute fuel reserve, is given as 2,475 naut. miles with a 2,000 lb. payload. Use of clam-shell type thrust reversers will reduce the landing run to less than 2,000 ft. from touchdown, and the leading edge flaps will cut the stalling speed to 86 knots.

Deliveries of the JetStar from Lockheed's Marietta factory are scheduled to begin in 1961. Three firm orders have been announced to date, from Pratt & Whitney, Continental Can Co. and Ryder Systems Inc. The company will also produce the version of the JetStar with two Bristol Orpheus B.Or.12 engines if sufficient customers want it.

Looking at the Tu-114

WHEN the Tu-114 prototype, L 5611, arrived at Le Bourget for the Paris Aero Show it was on a maiden trip from behind the Iron Curtain. Although it has since been seen at New York International, comparatively few people have had a chance of inspecting it.

On its four-hour flight to Paris this 170-seat turboprop was carrying 90 passengers, including Mr. A. N. Tupolev himself. Its first pilot was Capt. Yakimov, and it had a crew of second pilot, navigator, radio officer, engineer and five stewardesses.

Two of the latter work in the aircraft's kitchen, which is down two flights of stairs on the lower deck, with two service lifts to the centre galley. The lower compartment is also used for the stowage of up to 30,000 lb. of freight. Inspection of the interior—which is entered by the hydraulically operated airsteps needed to bridge the gap between the entry door and the highest available normal airport steps—revealed a tasteful and well-finished layout.

Behind the front entry lobby, with its two toilets, is the first compartment, with 21 seats per side, each three abreast. Another small lobby, for coat racks, separates this from another 48-seat compartment with railcoach-type tables for use as a restaurant. Aft of the central galley are two Pullman-type compartments on each side of the central corridor, with curtains over the doors, three seats per side, and bunks folding down from the roof. In the rear of the fuselage is a 56-seat cabin, with six-abreast accommodation.

Illuminated notices at each end of the cabins warn passengers in Russian and English when it is necessary to "put on oxygen masks," which are neatly stowed out of sight in fairings between the window ports. Seat belts are provided for all passengers throughout the Tu-114, which will enter service with Aeroflot as a 220-seater.

Although present at Le Bourget, and down on the flying programme, the Tu-114 did not become airborne between its arrival and departure from Paris. It appeared overhead precisely on schedule on its arrival flight, with a soft rumble from its 12,000 s.h.p. NK-012M turboprop units, and remarkably little airscrew noise. Its enormous counter-rotating propellers have solid alloy blades, with rubber de-icing shoes on the inner leading edges. The turbines exhaust through twin tailpipes flanking the nacelles, the inner "waisted" pair of which showed signs of strain on their blackened and buckled sides, bisected with rows of external stiffening ribs.—J.E.F.

Background to the F.A.A.

JUST as the designations and the duties of the now-abolished U.S. Civil Aeronautics Administration and the still-existing Civil Aeronautics Board caused confusion on this side of the Atlantic, so the spheres of influence of the new Federal Aviation Agency may still be misunderstood. In our issue of February 27 this year (pp. 240-241) we outlined the work of the F.A.A. and illustrated the breakdown of its departments with the help of a family tree. But there may still be doubts about the background history of the Agency and about the responsibilities which it has taken over from the C.A.A. and C.A.B.

Briefly, the F.A.A. can be described by quoting the words of Mr. E. R. Quesada on his appointment as administrator of the Agency. "It is," he said, "more than an expanded Civil Aeronautics Administration . . . or a revamped Military Airways and Air Communications Service. It is a true Federal aviation agency, in which are combined specific aviation functions previously scattered among several agencies." Apart from reducing diffusion of authority in U.S. aviation, both civil and military, it is intended to ensure the maximum correlation of civil and military needs in ATC and air navigation systems and its authority is at a level responsible directly to the President of the United States.

In 1955 a study group was appointed, under the direction of Mr. William B. Harding, to decide on a course of action which would improve the Federal aeronautical services. The recommendations of this group led to the appointment of Mr. Edward P. Curtis as special assistant to the President for aviation facilities planning. His report, submitted in May, 1957, led in turn to the establishment of the Airways

Modernization Board and a year later Congress passed the Federal Aviation Act which created the F.A.A. The Agency is, in effect, a consolidation of the A.M.B. and the old C.A.A. and that part of the C.A.B. which wrote the rules for air safety.

The C.A.B. retains its status as an independent agency responsible for the economic regulation of the airlines and for accident investigation; it also serves as a medium through which appeals can be made against any action involving the denial, modification, suspension or revocation of a certificate.

The effect of the Federal Aviation Act of 1958 was to cancel the Air Commerce Act of 1926, the Civil Aeronautics Act of 1938 and the Airways Modernization Act of 1957. The C.A.A. was abolished and its functions under the 1938 Act were transferred to the F.A.A. on December 31, 1958. Those of the new A.M.B. had already been transferred on November 3, 1958. As an industry executive remarked after its formation, "The F.A.A. brings new order to the letters floating in the bowl of alphabet soup that has been government regulation of aviation." In short, U.S. air transport, in all its facets, has, since January of this year, been looked after by just two organizations—the F.A.A. and the C.A.B.

The Agency is responsible, among less important activities, for: safety regulations (C.A.R.s), aircraft certification (12,500 lb. and over) and inspection of air navigation facilities; research in and development of air navigation and ATC facilities; the establishment and operation of air navigation facilities; air traffic management; and the provision, as required, of technical assistance and training facilities in other countries.

Postscript to the 707 Troubles

NOW that most of the hubbub is over it might be as well to put on record some of the details of the trouble experienced in the Boeing 707 with undercarriage and hydraulic system faults.

The undercarriage trouble was, as outlined in our issue of August 21 (p. 40), caused by snubber failure, coupled, in at least one case, by servicing deficiencies. The main undercarriage of the 707 has pairs of wheels mounted at each of a fore-and-aft beam which is centrally pivoted in a fork at the base of the main leg. An hydraulic snubber is used to damp oscillations of the beam and, in particular, to prevent excessive bucking of the beam caused by torque and other effects when the brakes are automatically applied during retraction.

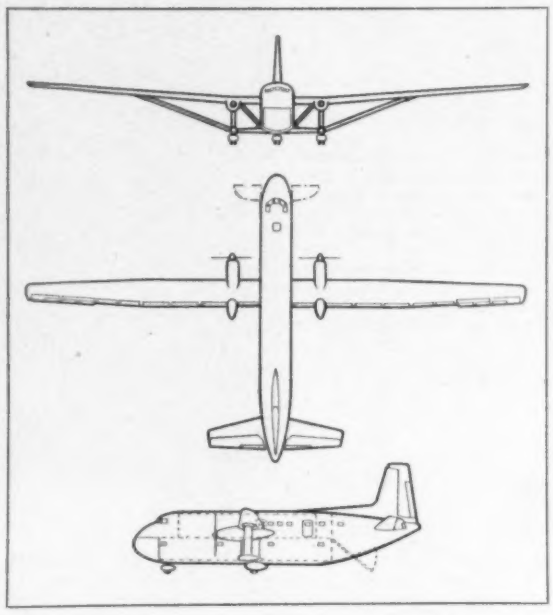
Because of failures of the snubber, excessive bucking was sometimes experienced and the beam hit the top of the fork —causing impact damage to the beam and, in the case at Idlewild, actual breakage. As an interim precaution the beams were inspected for dents and, when necessary, replaced. Modifications to prevent a recurrence of the trouble include a reduction of the automatic braking pressure and an increase in the hydraulic pressure in the snubber, which is being re-worked.

So far as the hydraulic failures are concerned, these appear to have been caused by surging; modifications involve either the fitting of a new type of hydraulic pump which incorporates an integral by-pass or the installation of a separate by-pass to deal with excessive pressure build-up during operation of the landing gear.

A Car Ferry Project

LATEST in the series of Hurel Dubois projects based on the ultra-high aspect ratio wing which is a feature of this French company's products, is the H.D.37. Offered as a general passenger and freight transport with provisions for a wide variety of mixed loads, the H.D.37 is of more particular interest as prospective equipment for the cross-Channel vehicle ferries. Silver City Airways have expressed interest in the project, more especially if it can be made in Britain, and have an estimated requirement for 15 or so within the next two years.

Based on the H.D.34—a twin-engined survey aircraft produced for the French Institut Géographique National—the H.D.37 differs from its predecessor in having a new, two-deck fuselage with nose loading, and Rolls-Royce Dart 527 turbo-



Three-view drawings of the projected H.D.37.

props in place of Wright Cyclones. The powerplant installation has been directly adapted from that of the Viscount.

As a vehicle ferry, the lower deck, 53 ft. long and 7.2 ft. wide, would carry three or four cars, depending on their size. The upper deck, 9 ft. wide, is divided into forward and rear areas by the wing centre section. The floor of the 18-ft. forward area includes a section which can be lowered and raised by electric winch and which carries one car. The 23.3 ft. rear section would be arranged for 24 passengers and is reached by a staircase from the lower deck. A door incorporating integral steps is located in the bottom of the rear fuselage adjacent to these stairs.

A total of 64 passengers could be carried on the lower deck, in addition to 24 on the upper deck, in a high density layout, or various combinations of freight and passengers. Military loads would include four Jeeps and 24 troops; three 105-mm. guns and 12 troops; or 60 wounded including 44 stretcher cases.

General appearance of the H.D.37 is shown in the accompanying three-view drawing. A preliminary specification follows:—

DIMENSIONS.—Span, 152 ft.; length, 85 ft. 9 in.; height, 32 ft. 10 in.; gross wing area, 1,098 sq. ft.

WEIGHTS.—Operating weight empty (less crew, fuel and payload), 28,704 lb.; max. take-off and landing weight, 51,147 lb.

PERFORMANCE.—Economical cruising speed, 145 knots at 1,475 ft. at 50,700 lb. weight and 12,000 r.p.m.; fast cruise, 178 knots at 9,842 ft. at 50,700 lb. weight and 13,000 r.p.m.; balanced field length (50 ft. screen), 4,200 ft.; landing distance from 50 ft., without reverse propellers, 3,050 ft.; range, no reserves, still air, max. fuel (1,144 Imp. gal.), 982 naut. miles with 12,368 lb. payload, at 9,840 ft. at 178 knots; range with 18,265 lb. payload, 300 naut. miles with 45 minutes +5% reserve fuel.

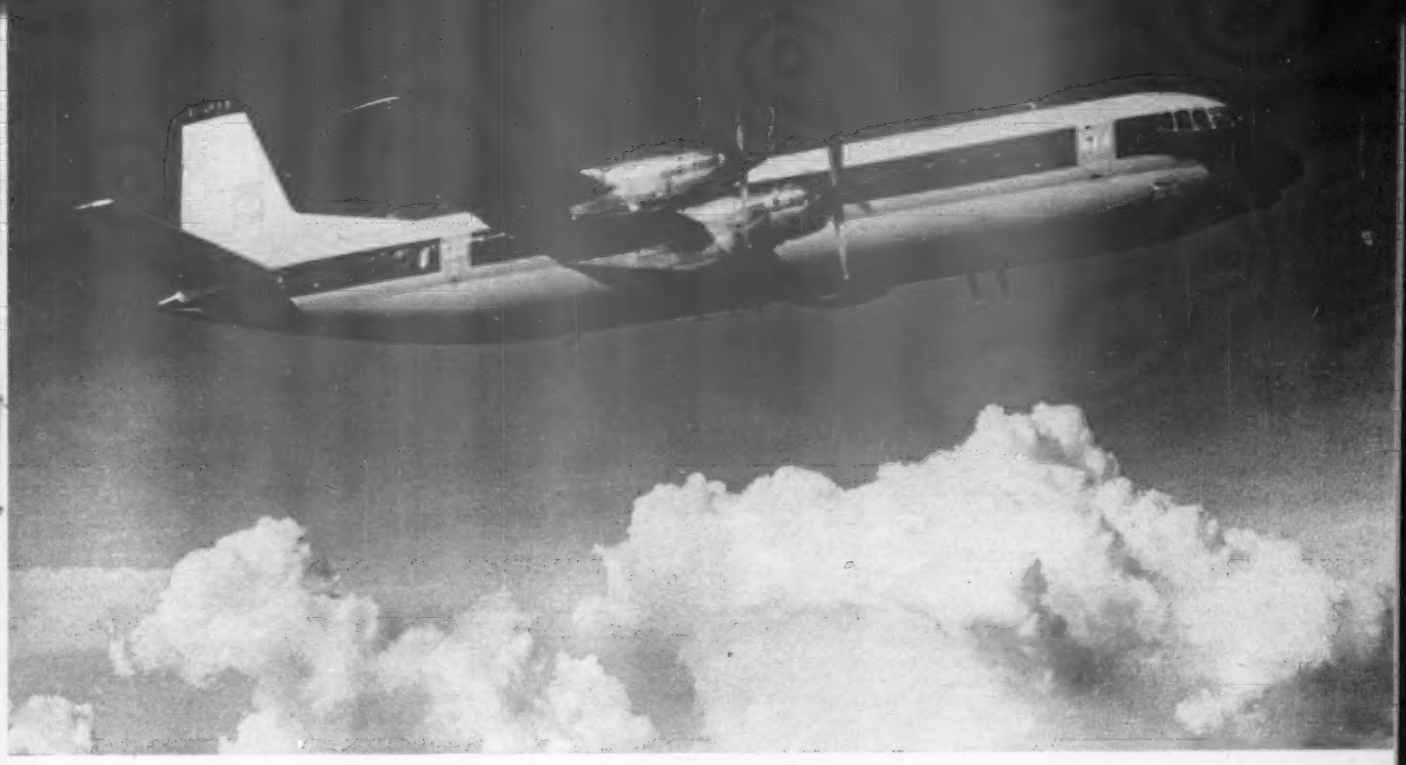
B.E.A.'s Better Year

THE very great improvement in B.E.A.'s traffic results this year can be seen in these tables which summarize the figures for May and June and compare them with those achieved during the same months of last year. The passenger-mile figures, for instance, were up by 23.6% and 20.6% respectively and —more significantly, perhaps—the freight ton-miles rose by 26.9% and 25.6% in the two months. Percentage load factors improved from the high 50s to the high 60s.

In June B.E.A. carried its 20 millionth passenger and, more recently, have recorded, for the first time, three million passengers in a single year. Profit for the 12 months ended June 30 was about £1,250,000.

B.E.A. RESULTS FOR MAY AND JUNE, 1959

	May, 1959	May, 1958	Variation	June, 1959	June, 1958	Variation
Capacity ton-miles offered	16,885,000	16,212,000	+ 4.2%	19,565,000	18,190,000	+ 7.6%
Load ton-miles sold	11,592,000	9,344,000	+24.1%	13,364,000	10,804,000	+23.6%
Revenue load factor	68.7%	57.6%	+19.3%	68.3%	59.4%	+15.0%
Passengers carried	292,200	243,500	+20.0%	344,003	294,343	+16.9%
Passenger-miles flown	104,667,000	84,654,000	+23.6%	122,513,000	101,588,000	+20.6%
Passenger load factor	70.4%	59.5%	+18.3%	70.1%	61.9%	+13.2%
Freight ton-miles	1,236,200	975,200	+26.9%	1,191,700	948,600	+25.6%
Mail ton-miles	322,100	300,800	+ 7.1%	307,200	287,800	+ 6.7%
Aircraft miles flown	3,266,500	3,238,900	+ 0.9%	3,864,000	3,728,000	+ 3.6%
Revenue hours flown	16,662	17,655	− 5.6%	20,011	20,648	− 3.1%



First Impressions of the Show

WHAT is the magic of Farnborough? It has a certain something that makes the most sophisticated of regular visitors come back year after year and that in spite of the critical analysis which demonstrates without shadow of doubt "that this year there cannot really be anything new." The same magic sends the multitudes away saying "You know, those chaps in the Hunters or the Scimitars or the helicopters or whatever, put on a marvellous show."

Year by year, in spite of contraction in Government orders and the limitation of this and the mergerization of that, the number of stands goes on rising. In this, the twentieth of S.B.A.C. Shows, there are more stands and indeed more caravans or chalets than ever before. And in the hot September weather in which it opened it looked as if it might be seen by a lot more people.

The big marquee seems to have got even bigger but whether it has got cooler is a moot point; the swirling punkah fans were generally admitted to have done something to improve the air circulation. Many people reported it to be extremely warm.

The increased area of the stands has been put to good advantage. There has been increased use of moving picture projectors and in full colour.

Most visitors would probably agree that the most interesting things on the stands were the new engines, nine of them. Details will be found under the appropriate section, but it is interesting to see that the British products cover the fan range and a wide variety of powers. For the first time the paired RB 108 power units of the Short SC-1 were on show. It was generally regretted that this most interesting machine had not got to a stage of being demonstrated on the opening Tuesday. It arrived after the Show on Tuesday and its hovering potentialities were to be demonstrated for the rest of the week.

The Hovercraft, though not in the same field at all, seems to us to be of aeronautical interest in view of the possibility of using the air cushion effect as a novel type of undercarriage. Of course, the Hovercraft is not an aeroplane nor will it ever be. It points the way to the development of vehicles riding on air cushions and in consequence able to ride over solid ground, marsh or water in a way no other known craft can. It would be interesting, and almost certainly profitable to speculate on the implications of this capability applied to aircraft.

Of aircraft proper there are five new types at the show, two new trainers, one of which, the Gnat Trainer, took the air only a week before the show and put in 10¼ hours flying in 18 flights. Its constructors take understandable pride that the first flight took place as scheduled when the I.T.P. was placed two years previously.

The new tactical transport and commercial aircraft, the Argosy has done much flying, in fact five have reached this stage. The Vanguard is seen in public for the first time. Nor has the Blackburn NA.39 been seen on the aerodrome in public before.

This year there are two of the big new Westland Westminster helicopters. If there is only one Rotodyne, certainly the news about it is extremely encouraging. Development is to go ahead on a M.o.S. contract. Details for military versions and that for B.E.A. are being thrashed out. This lead is certain to be followed and American development can be expected since Kaman have the licence.

At the opening of the Show there was much talk about the decision of the Minister of Supply to place a contract for the design study of a supersonic airliner. Once again the M.o.S. will call for a pooling of resources. Tenders on such a basis have been invited from a number of firms. One announced contending combination is that by Hawker Siddeley and Bristol; the latter is to fly an all-steel supersonic research aircraft in the next twelve months.

The shape of things to come for the Army is foreshadowed by the Bristol 192, the fourth of a batch of 20 for the R.A.F., the first squadron is to form next year.

It is a far cry from such power craft to the motorless sailplanes but these too have been earning some exports, and in consequence it seems arguable whether they should not have been demonstrated on one or two of the official as well as on the public days. These silent aircraft certainly provide an admirable foil to the noisy jets which dominate the Show.

Of the widely varied field of static exhibits it is impossible to speak at length in the short space available for this summary. It is good to see the two-stage Black Knight (slight though it is in comparison with the big American rockets) dominating the show from the plateau on which stands the static marquee. The great day will be when Blue Streak, at present shown in half-scale model form only, is installed underneath the Black Knight making the British satellite combination.

It would be as well to recall here that our rocket expenditure on Black Knight has been economic to an almost comical degree, some £5,000,000 in all. But their record is one to be proud of, not a single failure in all the launchings to date.

Without a doubt a most significant series of exhibits at the Show are those such as the Airpass developed by Ferranti and the Blind Landing System, becoming known as Autoland, in the electronics field. The whole of the working of the system can be studied on the M.o.S. stand, though the individual components are to be found on the stands of the manufacturers involved including the fascinating radio altimeter accurate to some 2 ft. worked out by Standard Telephones.

The combined system is unique in the Western World, and judging by the way in which the Russians are buying civil airline radio and navigation aids in this country, it is tempting to assume behind the iron curtain too. The great thing about this system is the fact that all the vital equipment is carried in the aeroplane and is therefore under the control of the operator. The only ground equipment required, the leader cables, are simple.

Display Highlights at Farnborough

Stealing the show, the Hunters of 111 Squadron.

HOT sunshine drawing a heat shimmer from runways and parched grass; dust-devils whirling scraps of paper high up to the base of fair-weather cumulus clumps; shirt-sleeved technicians soaking up equal shares of information, atmosphere and late summer solace: this was the setting for the opening day of the 20th S.B.A.C. Flying Display. Add to it the floating shapes of waiting aircraft, further distorted by the rippling jet exhausts of "Treble One's" 16 sleek Hunters as they creep out, nose to tail, like a long black shining snake, behind the fastidious red-and-white trim of the C.F.S. Jet Provosts. And complete the colour-crammed throbbing scene by the probe-tipped camera-carrying Scimitar exercising the prerogative of the Senior Service in taking off with a blast of twin-Avon power to open the afternoon's programme.

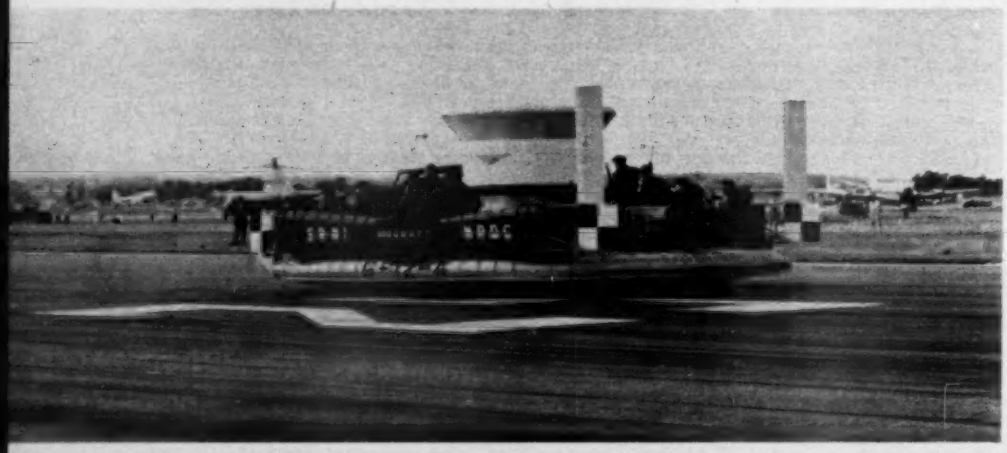
Visitors to Farnborough this year are prepared for the fact that there are fewer new items to be seen in an abbreviated flying programme, but after Monday's opening performance, they will be agreeably surprised by what is presented to them. Service participation, which is larger than ever this year and more successful than at any previous time, can take much of the credit for this. But it is also a "user's" display; nearly all the aircraft in the flying programme are being demonstrated carrying their internal or external loads.

In the case of the Saunders-Roe Hovercraft, which is making its first public presentation this week, and must be reckoned as the principal technical novelty of the flying display, its burden of 20 husky and fully-armed Royal Marines is carried externally, but can be regarded as a "normal" payload in so far as it demonstrates the extraordinary load-carrying capabilities of the "air-cushion" vehicle.

With its crew of two (pilot: Peter Lamb), the S.R. N-1 is daily demonstrating its ability to lift 22 men and propel them at 25 knots on a total of 430 b.h.p. Of this, some 30% is used for propulsion.

Having completed about 60 hr. "flying" to date, the prototype Hovercraft is now operating without the "elevons" originally fitted at each end of its propulsion ducts, these controls having been removed as being ineffective. At Farnborough, the four wheels of the beaching gear were also removed to allow the reduction in operating height from 12 to eight inches resulting from the heavy load.

The Hovercraft lifts off the ground without any fuss or bother, accompanied by a cloud of dust from the dry grass on which it starts. Its spot manoeuvrability on the runway appears as good as most helicopters, and its "high-speed" run along the strip



(*Left*) With burly and fully-equipped Royal Marines on its ample decking, the Hovercraft cushions along the runway at a steady 8 inches and about 20 m.p.h.

Gp. Capt. D. P. Hanafin, O.C. Experimental Flying, and Cdr. K. R. Hickson, Commander Flying, R.A.E., brief the industry's test pilots prior to the start of the display.

Photograph copyright "The Aeroplane and Astronautics"

(*Above*) Grand finale of this year's Farnborough Show is the cross-over landing of No. 807 Squadron's Scimitars.

(*Below*) As the Westminster lays its 103 ft. bridge, the heaviest load yet lifted by a helicopter in Britain, the Whirlwind and Widgeon bring two vehicles along to cross it.

of tarmac, with the tall rudders waggling gently, is most impressive.

When turning at any speed over land, the Hovercraft skids noticeably sideways, but on water, the pressure indentation acts in the manner of a keel, and minimizes this effect. Landing is apparently simply a matter of closing the twist-grip throttle from the hover or forward flight, and sinking rapidly to ground or water on the deflating cushion of air.

Before the Hovercraft appears, however, the tone of the display has already been established by several scintillating items. The preliminary *hors d'oeuvre* of Canberra P.R.9, Conway-Vulcan and Comet 4B that precedes the R.A.F. display was represented only by the B.E.A. transport on the opening day, but No. 111 Squadron's two teams of nine and seven Hunter 6s gave a full-scale performance against a faultless summer sky.

The continuity provided by the two teams, coupled with the superb formation keeping, resulted in an exhibition of group aerobatics that must be without rival throughout the world. Mention must also be made of the synchronized aerobatics, including semi-flick rolls, of the C.F.S. Jet Provosts.

There were many other demonstrations that linger in the mind,

(*Above*) A complete Bloodhound, on its trailer, is lifted by the external sling attachment on the Bristol 192.

(*Right*) Cody's tree provides a distinctive setting for the stores-carrying and F.R. probe-equipped Sea Vixen on its approach to land.

In distinctive B.E.A. colours, the Comet 4 comes in to land at Farnborough.

Farnborough Highlights . . .

and several new aircraft making a memorable début before the public. On the civil side, these included the turboprop trio of Argosy, Herald and Vanguard, the Tyne-powered departure of the latter coinciding with the dramatic light-up of the Rotodyne's tip-jets.

In cruising flight, during their fly-pasts, all four transports were remarkably quiet; each had their individual elegance and decisive sales points. After its transition to hovering flight, and landing, the Rotodyne opened its rear clam-shell doors to disgorge a load of about 30 nurses.

Other cameos spring to mind. The fantastic take-off of the Vulcan 2, flown by Jimmy Harrison from the other end of the airfield, its great kinked-delta shape standing on the smoke-blackened thrust of its four Olympus 200 series turbojets, which gave it a total power equivalent to a five-engined Vulcan 1. The NA.39, making its first unrestricted showing in this country, and hurling its blue area-ruled bulk off the ground under the impulse of its Gyron Juniors, with the assistance of blown wings, flaps and tail, and drooping ailerons. The confidence in its flight test progress is being shown by Derek Whitehead with demonstrations of its extraordinarily rapid roll, additionally remarkable from a twin-engined nuclear bomber.

Another newcomer, the Gnat Trainer, is flying under slightly more restraint, having completed its statutory 10 (and a half) hours' initial flying in three or four days preceding the show, and being temporarily restricted to 450 knots E.A.S. and M=0.9. This does not prevent the effectiveness of its new outboard ailerons from being shown, however, by Ted Tennant, nor the improved take-off and landing characteristics, gained by the addition of separate flaps. A useful comparison is made possible by the simultaneous demonstration of a standard Gnat F.1.

One of the most significant flight items this year is Bill Bedford's prolonged spin in the Hunter Trainer T.66. This is the first time that a high-performance jet fighter has been so demonstrated, and there is no half-measure involved. From a very fast low run, the orange Hunter soars straight up, leaving a trail of smoke from its Diesel oil injection system, to about 15,000 ft., where it is just about identifiable.

The thin white thread of smoke then falters as the Hunter flicks over into a spin, the sun flashing on its canopy as it plummets down in turn after turn. From the corkscrew trail it leaves, some ten autorotations become evident, after a heart-stopping interval, before the Hunter dives steeply to recover, towards the airfield. It subsequent short-landing, with oversize tail parachute and all-wheel braking, is almost as dramatic.

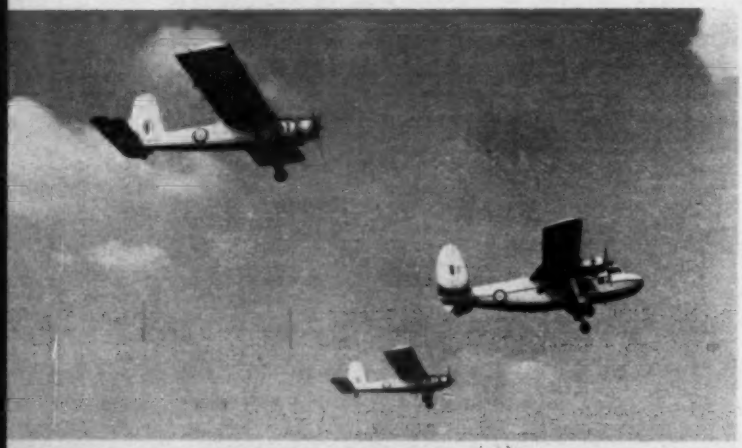
With ribbon parachute deployed and fuselage air-brakes extended, the two-seat Lightning T.4 concludes its invigorating display.

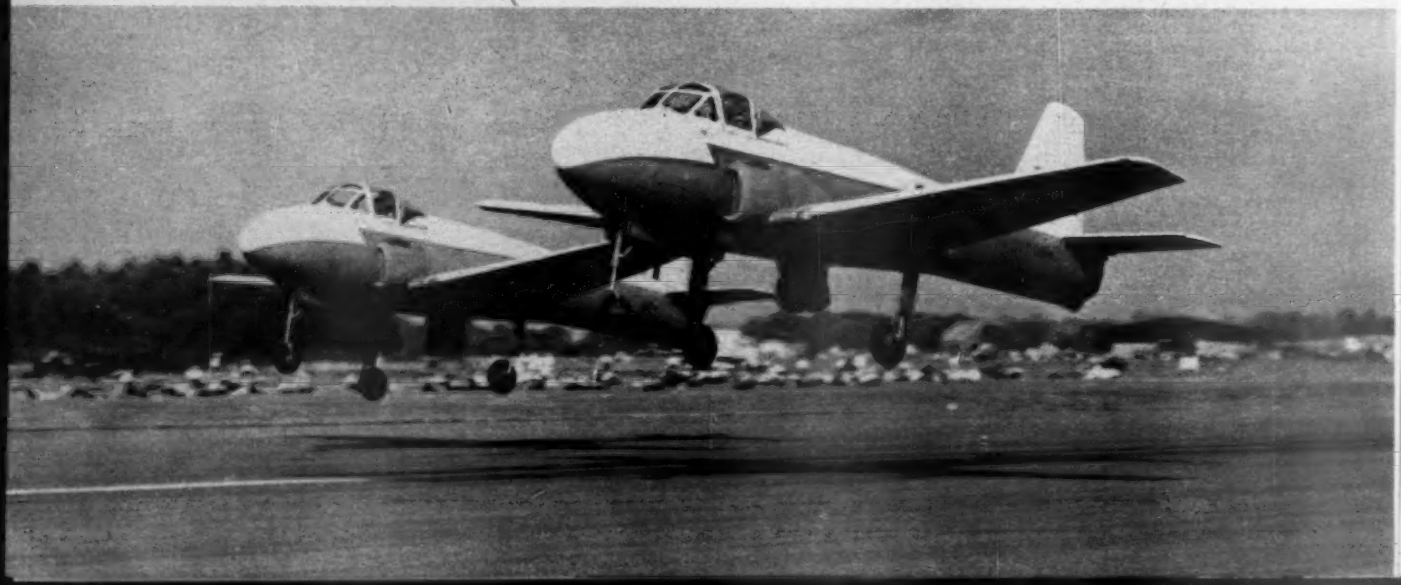
On a larger scale, the supersonic Lightning T.4 trainer, shows that little performance has been sacrificed to the additional seat, and this newcomer also demonstrates similar spine-cracking tight turns of an unimaginable g-quantity. Equally impressive, but of a very different nature, are the helicopters—especially the Westland-Saro circus. This comprises eight rotorcraft in all—two Westminsters, a Wessex, Gnome-Whirlwind, Leonides-Major Whirlwind, pontoon-Widgeon, Skeeter and A.129/P.531.

After a general cavort, one of the Westminsters lifts a 3,500-lb. bridge section, the Wessex raises a Land-Rover, and the Gnome-Whirlwind elevates a 1,200 lb. Austin Moke. The Westminster thereupon lays the bridge across two ramps in the centre of the airfield; the vehicles are lowered nearby and driven across the span; and all eight helicopters rejoin to line up and take their bow along the runway.

Bristol's 192 also demonstrates its aerial crane capability, after disgorging 18 troops, in picking up a Bloodhound surface-to-air weapon, complete with transporter, and carrying all 4,000 lb. or so of it triumphantly round the airfield.

The last word is left to the Navy. In a sizzling show, No. 807 Squadron's Scimitars take-off in finger-four formation, aerobat in changing sequence, use individual aircraft to make high-speed runs and snatch a transonic target dart from the runway, lob an imaginary A-bomb in a LABS run, accompanied by a gout of (petrol) flame and smoke mushroom at the end of the airfield, and culminate in a cross-over landing, with the aid of folded wings on the outer downwind pair.—J. E. F.





(*Left*) Heading the Transport Command fly-past are Scottish Aviation Pioneers—two singles and a Twin. (*Below*) Taking off for their pretty display of synchronized aerobatics are the two Jet Provost T.1s of C.F.S.

Farnborough First Report . . .

Missiles at Farnborough

SPACE-AGE missiles are much in evidence at Farnborough this year. Dominating the Guided Weapons Park is a two-stage version of the Saunders-Roe Black Knight, mounted on its launching platform. With the new solid-propellent top stage, it is hoped to boost the altitude performance from 500 to 1,500 miles and achieve a very considerable increase in "all-burnt" velocity.

Near the vehicle is shown an actual nose-cone of the single-stage Black Knight which had been recovered after a firing at Woomera. The nose-cone, which detached from the missile after-body during the ascent, had re-entered the atmosphere from an altitude of more than 500 miles at a velocity of about 12,000 ft./sec. Tracking data gave the position of the descending cone which was recovered from the scrub and desert sand of the Woomera range within a few hours of launching.

Data on re-entry heating and dynamic behaviour were obtained from instrumentation housed in the cone itself. In addition, experiments were made with various materials under re-entry conditions by attaching patches of material around the base of the cone; these patches which stood proud and partially burnt away have been removed for examination.

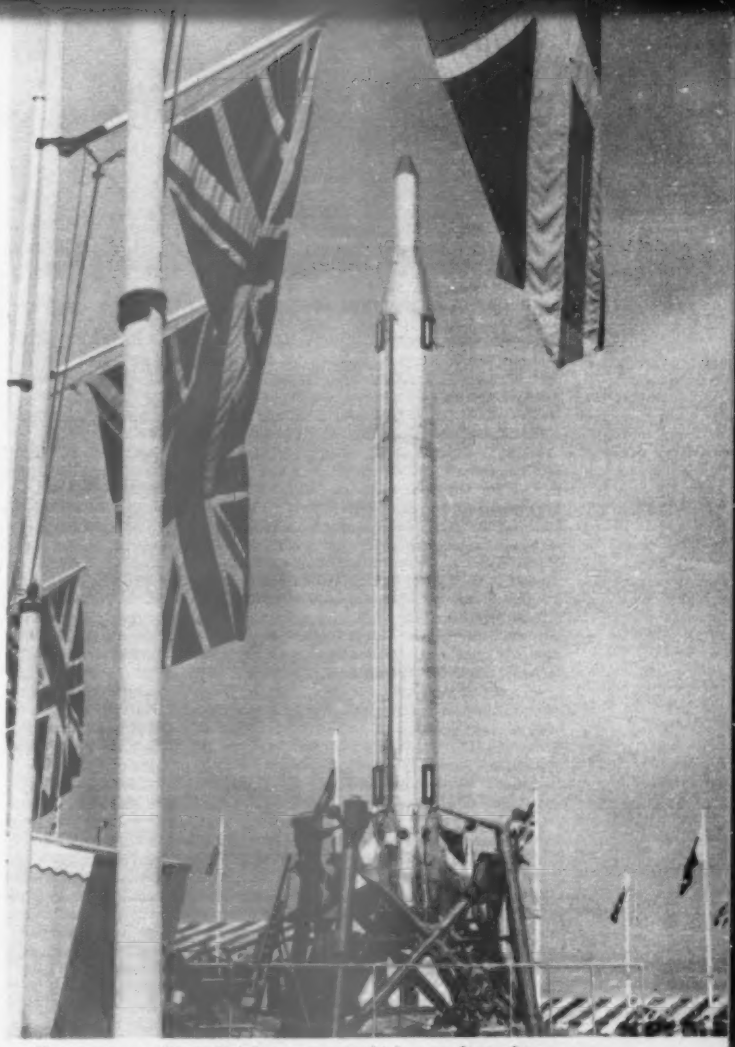
The nose-cone itself, which is little damaged apart from denting and a "concertina'd" nose, appears to be made of stainless steel and is tipped by a blunt plastic nosing, almost certainly placed in position after recovery. The cone was apparently recovered without parachute assistance and from the way it impacted, it would appear to have made a remarkably stable descent.

Details of the smaller nose-cone fitted to the new second stage are classified, but its shape clearly follows that of its single-stage predecessor. The higher speeds available with the two-stage version will produce re-entry conditions more directly applicable to the Blue Streak L.R.B.M., which is the primary object. First firing of the two-stage Black Knight is expected shortly.

Seaslug without boosters, and right, a complete missile deployed in the twin-rail launcher.

A dominant feature of the de Havilland Enterprise stand is a 1/5th-scale model of the Blue Streak. This is the first occasion that the nose configuration has been seen, though it is doubtful if the model is representative of the operational warhead and re-entry body. Nevertheless, the white-painted model gives an impressive foretaste of the actual missile, 70 ft. long and 10 ft. diameter, which should be launched for the first time at Woomera early next year.

Not only does it reveal a very potent ballistic weapon, but an equally great potential as a vehicle for satellite research when mated with the Black Knight. Indeed, it would seem that a combination of Blue Streak, Black Knight and the new solid stage would allow us to shoot for the Moon.



The two-stage Black Knight re-entry vehicle seen from the Guided Weapons Park.

Although the air-to-air de Havilland Firestreak has been seen many times before at Farnborough, this year is the first time visitors have been treated to a view of its guidance system.

Fitted with an operational nose consisting of eight optically flat glass panels, the infra-red guidance head can be clearly seen. The head is gimbal-mounted to move in pitch and yaw following the source of infra-red radiation.

The heat sensitive cell is mounted inside a central tube on the moveable head, the radiation from the target being collected by a forward-facing concave mirror fitted around the base of the tube. This mirror serves to focus the rays on to a rearward facing mirror mounted over the tube, reflecting them down on to the cell.

Error signals produced in the missile's electronic guidance system are then translated into control responses, which act on pneumatic actuators to move the tail fins. These steer the missile in pitch and yaw, while rate gyro's act for stability in roll.

Two rings of optical windows behind the guidance head are concerned with infra-red proximity fusing. These windows, normally clear, are painted over on the exhibit for security reasons.

Two examples of the Armstrong Whitworth Seaslug surface-to-air missile are shown in the Guided Weapon Park. One of these is shown without boosters and the other with boosters mounted on the rails of an operational twin-launcher.

Each of the four boost rockets is tipped by a flat disc—a feature which has been found necessary, in the light of trials, to assist stability and improve boost separation. Otherwise, the missile appears to be essentially the same as exhibited last year.

Evidence of approaching operational status was given in a report that six firings recently carried out with warheads fitted resulted in the destruction of all six target aircraft. So high is the "kill" rate of this weapon on test that the beam-rider target radar has now to be aimed off to obtain deliberate near-misses.

Four "County Class" ships are being built to carry the Sea-

Missiles at Farnborough . . .

slug system, and intensive trials have already taken place aboard the Royal Navy's guided weapon trials ship, H.M.S. "Girdle Ness." Seaslug has often brought down aircraft without the use of a warhead, it is reported.

An impressive demonstration of the English Electric Thunderbird weapon system is being given each day in the Guided Weapon Park by the 36th A.A. (G.W.) Regiment, Royal Artillery, who operate a control post, mobile launcher and A.A. No. 3 Mk. 8 target tracking and illuminating radar. The weapon is seen tracking round on its zero-length launcher in conjunction with the target radar.

Thunderbird is now undergoing final acceptance trials in Australia before being turned over to operational units of the British Army.

A new version is under development which embodies solid-propulsion units of higher specific impulse and a guidance system of longer range, said to be a constant-wave radar system.

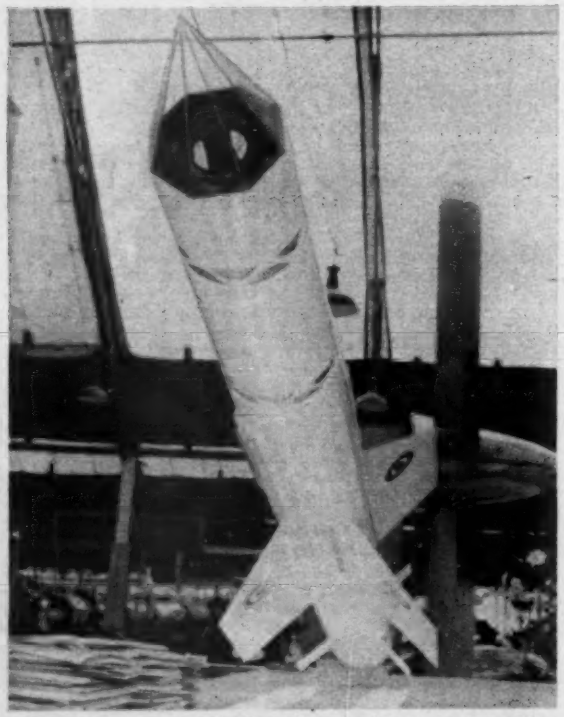
Bristol/Ferranti's Bloodhound again appears in the G.W. Park, and is shown tracking, elevating and depressing on its zero-length launcher. Another example is shown in sectioned form revealing the wing-lock mechanism, fuel turbo-pump, the Mach number control unit, and high- and low-pressure hydraulic accumulators, etc. The semi-active guidance pack and radar dish are also exposed to view. Bristol's also talk of a "second generation" weapon system.

English Electric Aviation announced on September 9 that the company was responsible for the design and development of a new Army corps-support missile. This is no doubt one of the tactical nuclear weapons mentioned in the 1959 Defence White Paper.

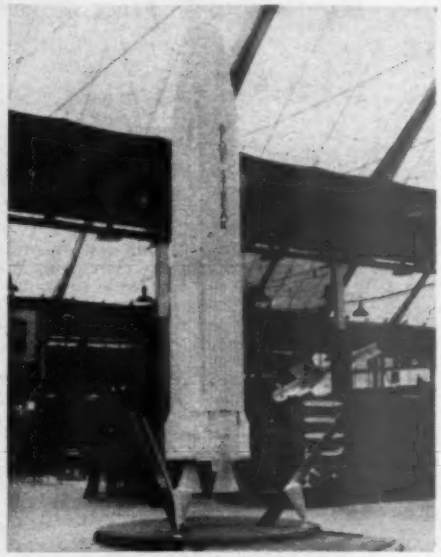
Little detail was given in the company's release, but as a modern Army missile this new weapon doubtless has a solid-fuel rocket motor and will have been designed for mobility and transport by air. It may well have an inertial guidance system; English Electric exhibited a miniature stabilized platform which, according to the company, "means that inertial guidance can now be fitted in a wide range of comparatively small tactical missiles and aircraft."

This new missile will probably replace the Corporal SSM which is now in service with the Army. When the Army adopted the Corporal, English Electric was appointed its "foster-parent" in the U.K. and has provided some of the technical support services for this missile.

Four Short Seacats on a typical Seacat launcher are shown in mock-up form. This missile, which is under development for the Royal Navy as a replacement for the 40-mm. Bofors gun, is also being produced as a land-based version under the name Tigercat. The latter, a private venture, is being undertaken jointly by Short's and Elliott Brothers (London) Ltd.

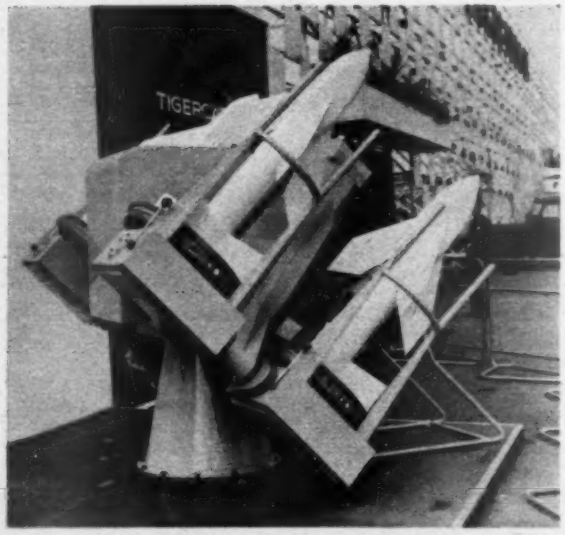


Firestreak seen for the first time with infra-red "eye" revealed, and proximity fuzing windows.



A 1/5th scale model of Blue Streak on the stand of de Havilland Enterprise. The 10ft. baseboard has the same diameter as the actual missile.

On view for the first time at Farnborough, on the Ministry of Supply stand, is the Malkara, a wire-guided solid-propellent anti-tank weapon developed in Australia at the Government Aircraft Factories in Melbourne. A year ago it was announced that Britain had bought 150 Malkaras and subsequently, 30 were



Seacat quadruple launcher, with four model missiles in position.

delivered for acceptance trials at Kirkcudbright in Scotland. In August this year, a substantial order was placed by the Ministry of Supply on behalf of the British Army.

Malkara is wire-guided over a range of two miles. It has cruciform wings and is launched from a mobile platform; it is not regarded as an infantry weapon. In addition to being used against heavy tanks it can also be used against fortified defence positions, landing craft and small ships. The missile has a length of 6 ft. 6 in., a span of 2 ft. 8 in., a launch weight of about 200 lb., and the hollow charge warhead weighs between 50 and 60 lb.

Other missiles on show are the Pye anti-tank weapon, also wire-guided and powered by a two-stage solid rocket; the similar but smaller Vickers Vigilant V.891 anti-tank missile; and models of the Avro Blue Steel stand-off bomb. Bristol Aerojet are also showing a model of a high-altitude research rocket, similar to Skylark, which has been developed for the Canadian Defence Research Board.

Farnborough First Report . . .

New Exhibits and Exhibitors

AMONG the record number of stands and exhibits in the indoor exhibition and outside display sites in this year's static show are a wide range of new products and accessories. Covering various, if not all, aspects of the industry and aviation in general, these " firsts " include new exhibitors to Farnborough as well as new exhibits.

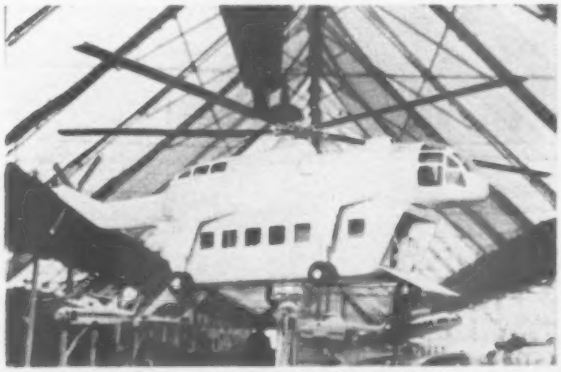
Engine, airframe and component test equipment development is well in evidence, but from the very nature of many items, models and diagrams are often employed to illustrate the actual component or system. John Curran, for example, is displaying an ¼th-scale model of the latest addition to its range of turbojet test stands. This has a thrust capacity of 30,000 lb. and has been designed for the checking of such powerplants as the Rolls-Royce Conway and Pratt & Whitney JT.3 and 4 series engines, as installed in the Boeing 707 and Douglas DC-8 transports.

On the Ministry of Supply stands there is a vibrations measuring device employing two finely ruled optical screens which are identical and superimposed. One is fixed, the other is attached to the member under observation. Considerable optical magnification of movement occurs and this may be viewed stroboscopically or be photographed by ciné camera.

A new method of measuring the unbalance of helicopter blades under dynamic conditions is demonstrated by The Wayne Kerr Laboratories in model form. In this, no attachment to the blades is necessary; and a direct measurement of the height of each blade is obtained with respect to one reference blade. The measurement can be taken at any point along the length of the blades and can be obtained over a range of rotational speeds.

Materials on show include two new alloys—titanium 230 and 679—which are now being produced by the Metals Division of Imperial Chemical Industries in commercial form. Titanium 230, available in a number of wrought forms, has a minimum tensile strength of 32 tons/sq. in. in its soft condition, which can be raised to 45-33 tons/sq. in. by subsequent ageing. Titanium 679, a high temperature creep-resistant material, has been developed to withstand high stresses at temperatures above 400° C, giving it a short-term tensile strength of 52 tons/sq. in. at 500° C.

Exhibiting for the first time at Farnborough, Laporte Chemicals is featuring H.T.P. as a compact, safe source of power. On three stands the company is illustrating the major aspects of the production, use and handling requirements of the propellent, and demonstrating live firings of a typical small rocket unit—a Napier/Saro rotor-tip booster—working on H.T.P. A 600-gall. tanker and a 500-gall. demountable shipping tank are also displayed outside.



A new version planned for the Westland Westminster is the crane transporter, which uses the complete rotor and transmission system of the existing prototype. The 1000-lb. pod shown could carry 50 equipped assault troops.

Aircraft component developments include a new fan-cooled wheel brake, which is estimated to reduce cooling time by as much as 80 per cent., produced by the Aviation Division of the Dunlop Rubber Co., Ltd. Basically the brake does not involve major modifications to existing equipment and consists of a small ducted fan introduced into the heat sink within the wheel.

Boulton Paul Aircraft is displaying a set of powered flying control units for NA.39 for the first time. Made up of aileron, tailplane and rudder units, each component comprises a tandem hydraulic ram operated from separate hydraulic supplies and controlled by rotary valves. The units can be operated in manual control, with or without autostabilization, or under complete autopilot control.

This year Flight Refuelling is displaying its new concept of flight refuelling in the form of the Mk. 20 refuelling pack. This is a self-contained ram-air turbine-driven unit designed to be fitted to standard underwing pylons of fighter and strike aircraft. It is suitable for use on refuelling operations up to an E.A.S. of 310 knots at altitudes of 40-45,000 ft. The pack can be carried on aircraft up to 500 knots or M=1.

Another military development on show at Farnborough for the first time is Airpass, the radar fire and control equipment produced by Ferranti. The two basic components of the system are the AI radar and the attack sight. The radar is search-and-track set, and includes a computer for calculating the correct course information for presentation to the pilot.

On a number of stands, including those of Normalair and Lockheed Precision Products, the emphasis is on civil transport components as opposed to military equipment. Normalair is showing a vapour cycle cooling system using pneumatic power for operation and control for aircraft such as the V.C.10, together with passenger oxygen equipment. New hydraulic components can be seen on the Lockheed stand.

In the electronic field one of the most outstanding items is the Blind Landing Experimental Unit's automatic landing system which is to be manufactured for possible civil markets under the name of Autoland. This system has been used for more than 3,000 successful landings to date. It is displayed in component and pictorial form on the stands of Murphy Radio, Smiths Aviation Division and Standard Telephones and Cables, the three manufacturers of the equipment, and by the Ministry of Supply.

The principal exhibit on the Elliott Aviation Division stand is a cut-away model of the V.C.10 showing the instruments, including the flight control system, which the company is supplying for the transport.

Displays and illustrations of new radio and navigation equipment include the STAN. 7-8-9 ILS ground installation, the DU.5 VHF ground transmitter and RX.20 VHF ground receiver on the Standard Telephones and Cables stand. Ultra Electric is exhibiting its crash position indicator based on the SARAH search and rescue homing aid, and Ekco Electronics has its new 56-lb. transistorized airborne weather radar on show. A five-channel lightweight VHF transmitter/receiver for light aircraft requirements has been developed by Burndept and the company has started a small production run of the equipment.

An interesting exhibit connected with radar is a glass fibre radome developed by a new technique providing an accuracy of .001 in. on wall thickness and .004 in. on diameter. Manufactured by Walter Kidde it is constructed from Polyester resin and glass roving.

There is much to see in the outside equipment park this year —dominant here is the new Zwicky Severn 10,000-gal. refueller, while on the left Laporte Chemicals, newcomers to the show, display H.T.P. equipment.

Display Highlights . . . .

Photographs copyright of the "Aeroplane and Astronautics"

(*Top*) Rotodyne and Vanguard draw the attention of many of the visitors from home and overseas. A helicopter view of one corner of the static aircraft park.

(*Right*) The NA.39 comes into land with flaps and ailerons drooped and tail airbrake extended.

Among the important guests in the president's tent can be seen Lord Mountbatten and the C.A.S. Marshal of the R.A.F. Sir Dermot Boyle.

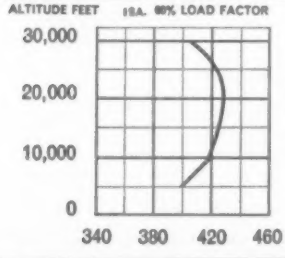
Only the VANGUARD

has this proved flexibility

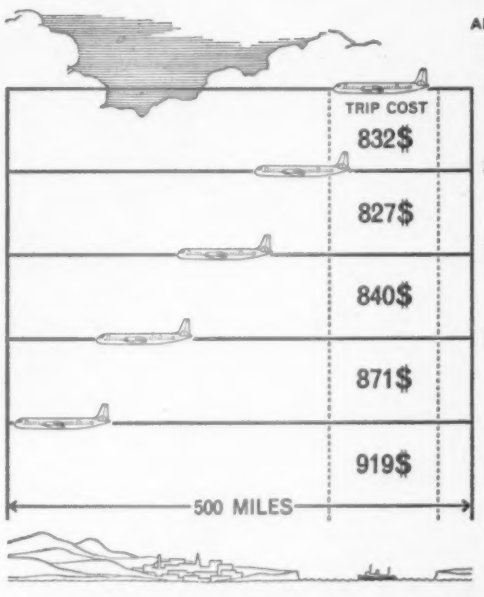
AIRLINE OPERATORS are invited to look carefully at this diagram and graph, and then compare the Vanguard's flexibility with their own experience of short haul operation on high-density routes.

It is easy to see that this remarkable aircraft can be routed at altitudes of from 5,000 ft to 25,000 ft and above, with practically no penalties in operating costs or speed.

The difference in direct cost between a 500-mile sector flown at 10,000 ft and one flown at an optimum of 20,000 ft is only $44 per trip. A cruising speed of over 400 m.p.h. is available between the height bands of 5,000 ft and 30,000 ft., so that schedules can be maintained irrespective of routeing instructions.



SPEED CAN BE MAINTAINED WHATEVER THE ALTITUDE ROUTEING INSTRUCTIONS



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Of all the airliners only the Vanguard has all these features

425 m.p.h. cruising • Freight capacity 10 tons at normal densities • Full routeing and A.T.C. flexibility • Can use normal existing airfields • Quick turn-round • No airfield noise problems • Ten years' unique Vickers/Rolls-Royce turbo-prop experience . . . ***And it is 'Viscount' quiet.***

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FOUR ROLLS-ROYCE TYNE TURBO-PROP ENGINES

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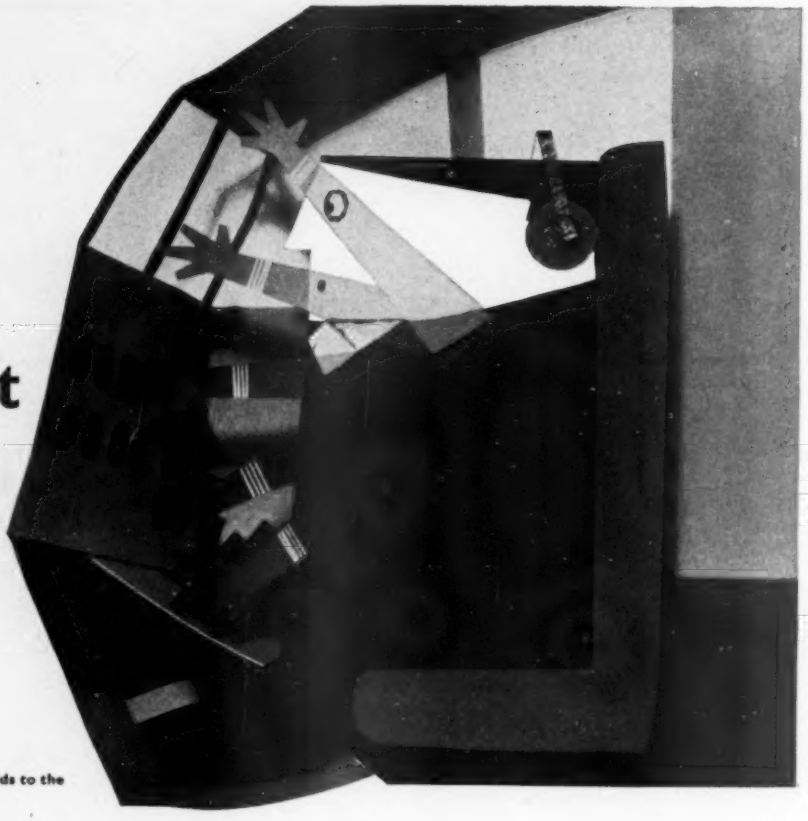


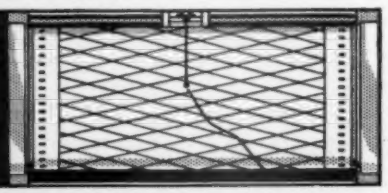
The IFALPA delegate speaking on point source aids to the ICAO Special Meeting, Montreal, February 1959

....**"It is a most unfortunate time to have to be fiddling with a receiver.** In order to tune in this type of station, you must switch off all of your other communications or else you will never pick up the Identification. One man in the cockpit is completely concerned with just one thing: tuning in the station – pressing his hands against his ears until he *can* identify it. The other man takes over the entire communications guard; continuously receiving clearances stepping the ship down, and also slowing it down; at the same time he is also operating a check list; this calls for conversation between himself and the other pilot if he can finish with his station identification. It is a very poor time to be distracted and pre-occupied with tuning a facility . . . there are eight holding stacks and of these six are non-directional beacons and the other two are intersections of radials from VORs. Holding on an intersection of two radials, you will be in a pattern something like this – one minute on this leg, a one minute turn, one minute on this leg, another minute turn and you are back where you started. On your Symbolic Display you centre the needle indicating the VOR radial from the left side; the VOR on the other side has a needle that is off-set, and as you approach the intersection, the needle on the other one will come into the centre—only at that one instant do you know exactly where you are. You then punch a stop watch and start a turn, using your directional Gyro and Turn Indicator—incidentally, you must hold your altitude with considerable precision because there are people above and below you in the stack. As soon as you leave this point both needles will be at various positions on the face of the dials and extremely difficult to interpret. As you come back into your pattern, the needle on the left should centre itself. If it does not you have wind drift, and you have a minute in which to correct it and bring it back into the centre.

'IS PICTORIAL PRESENTATION DESIRABLE?' I would say that it most definitely is. There is only one instant in this four minute pattern when you know exactly where you are, and that is only if within that minute you have been able to re-align yourself"...

. . . but you always know where you are with

THE DECCA NAVIGATOR



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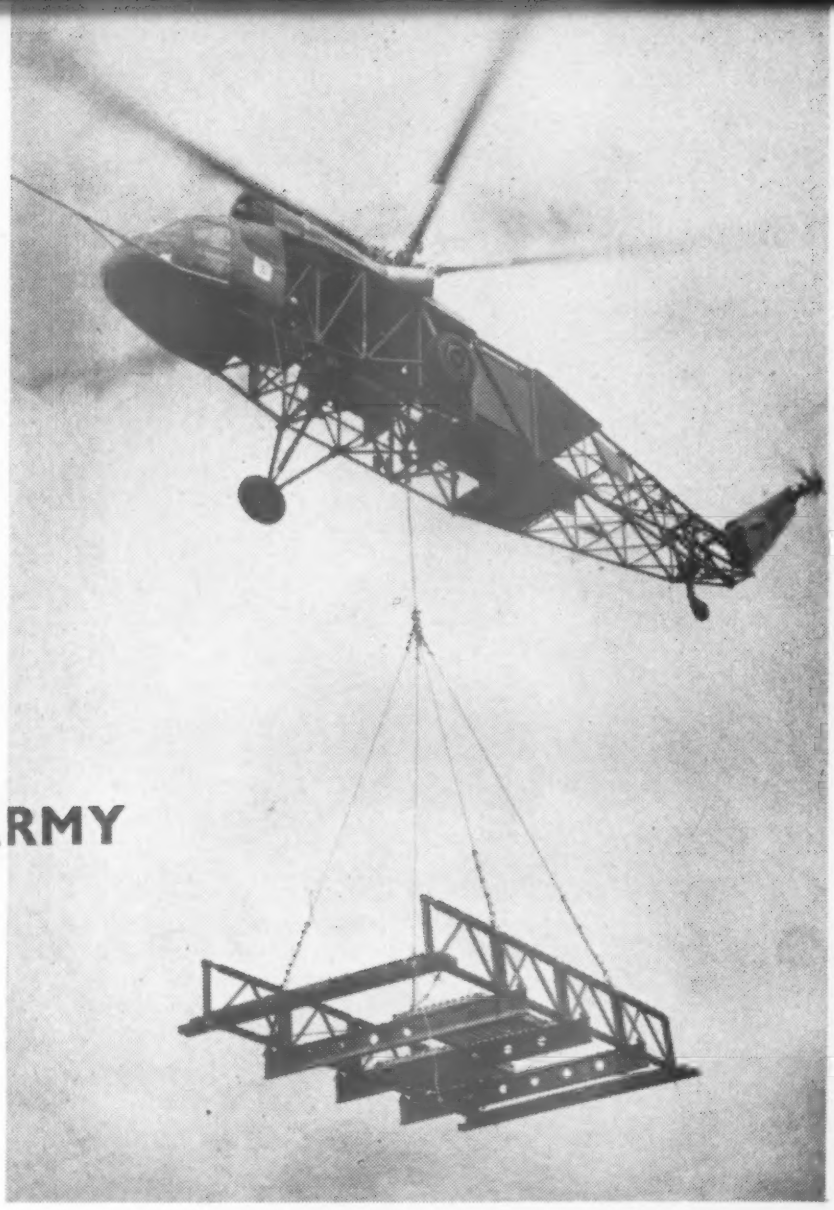

UPLIFT FOR THE ARMY

The Crane-Transporter version of the Westminster typifies a new concept for helicopter utilisation in military logistics. It meets the requirements for the rapid transport of heavy equipment from supply bases to forward areas in support of main forces or to small units operating independently over scattered areas.

Missiles, big guns, vehicles, field hospitals, living huts and a variety of other field equipment all come within the lifting capacity of the Westminster and can be held at the hover throughout the helicopter's duration.

In short, it is designed to take on the tough, heavy-duty transport work for the Army, and dispose of the supply problems posed firstly, by the absence of airfields and, secondly, by terrain impassable to surface transport.

The Westminster is powered by twin turbine engines and is able to operate on one of them with full load if need be.

Picture shows the experimental prototype of the Crane-Transporter lifting an Army bridging section weighing 6,140 lbs.

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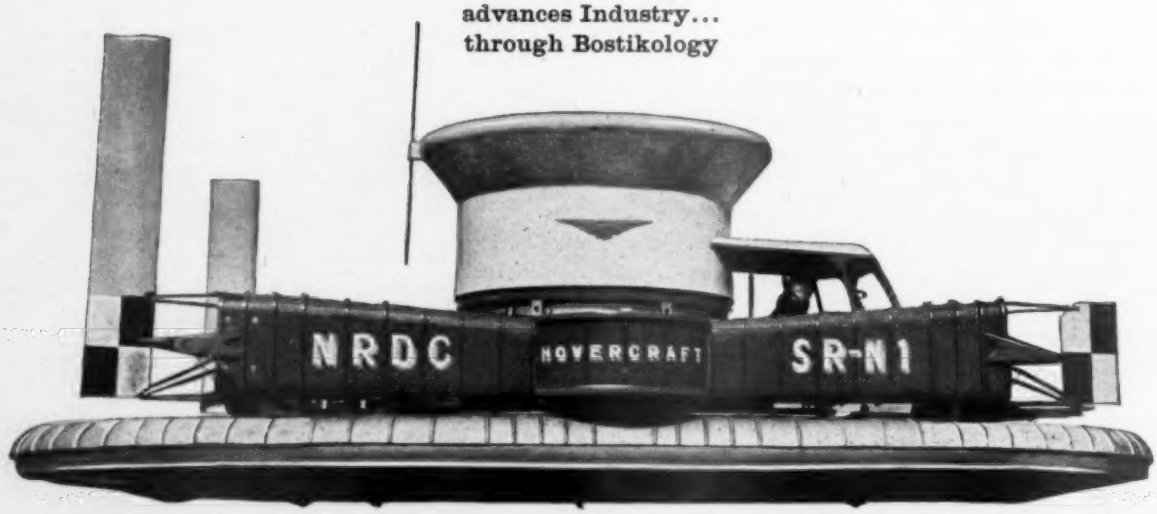
Just when we were wondering what the next means of travel might be, up went the Hovercraft and sped uncannily forward. What a magnificent achievement it is . . . and how proud are we that Bostikology contributed to its success. Bostikology, the knowledge of sealing and securing with 'Bostik' products, has extensive applications, and endless possibilities. If proof were needed of this, it is to be found on the Hovercraft.

Yes, it's congratulations all round!

Bostik

advances Industry...
through Bostikology



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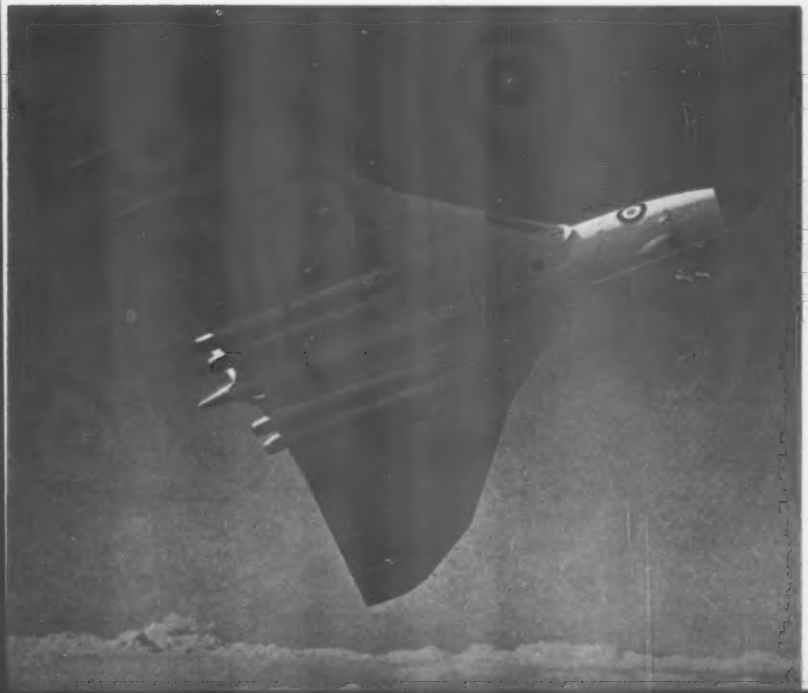
Farnborough

First Report . . . .

Exhibits in the Air

Photographs copyright "The Aeroplane and Astronautics"



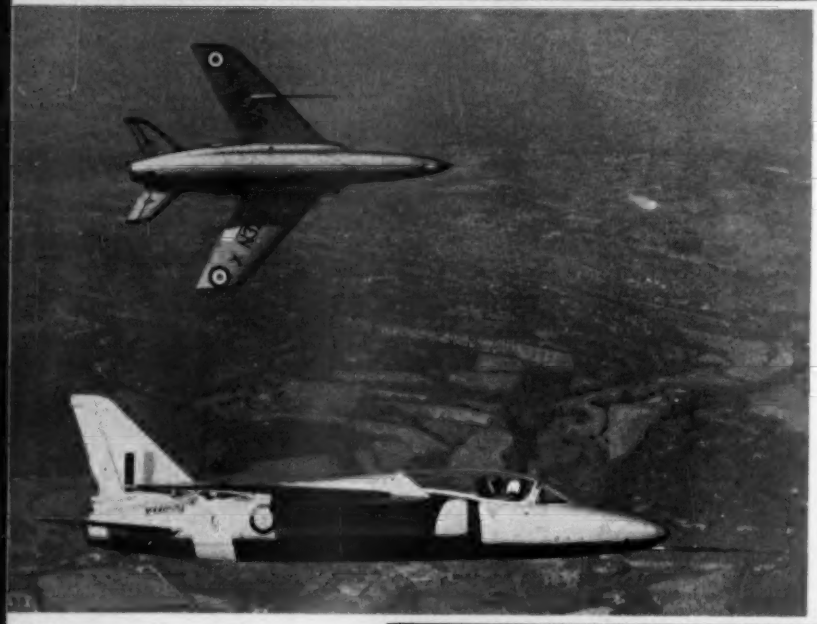
Top, thoroughly practical lines characterize the Armstrong Whitworth AW.650 Argosy general-purpose transport powered by Rolls-Royce Darts.

Above, the Fairey Gannet AEW. 3 displays its large early warning radar fairing; its powerplant is a Bristol Siddeley Double Mamba.

Left, a production Vulcan B.2 powered by Bristol Siddeley Olympus turbojets.

Above, the two-seat Lightning trainer (foreground) poses with a standard single-seat Lightning; each has two Rolls-Royce Avons.

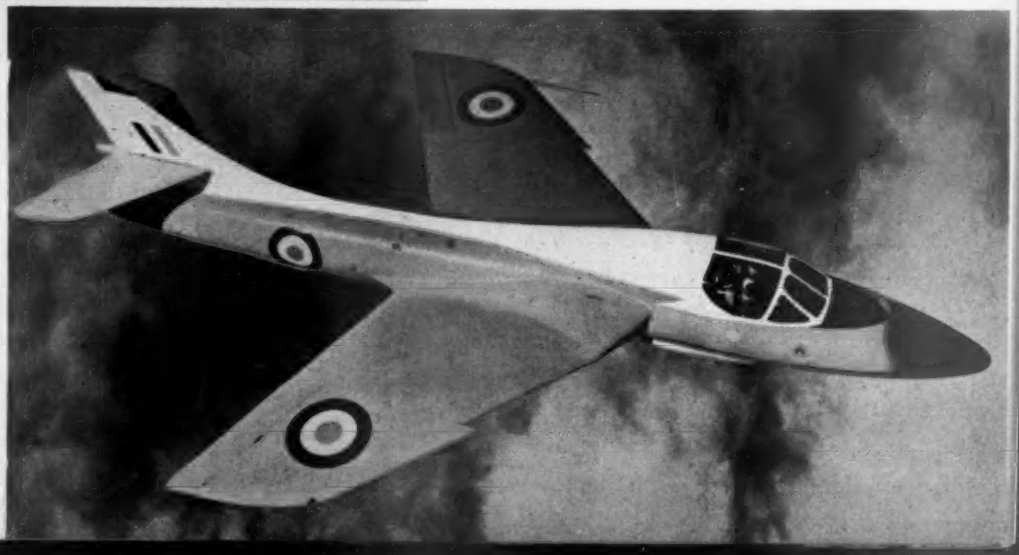
Exhibits in the Air . . . .



Left, two more of a kind—the new trainer version of the Gnat (foreground) and the single-seat Gnat; Bristol Siddeley Orpheus turbojets provide their power.

Photographs copyright "The Aeroplane and Astronautics"

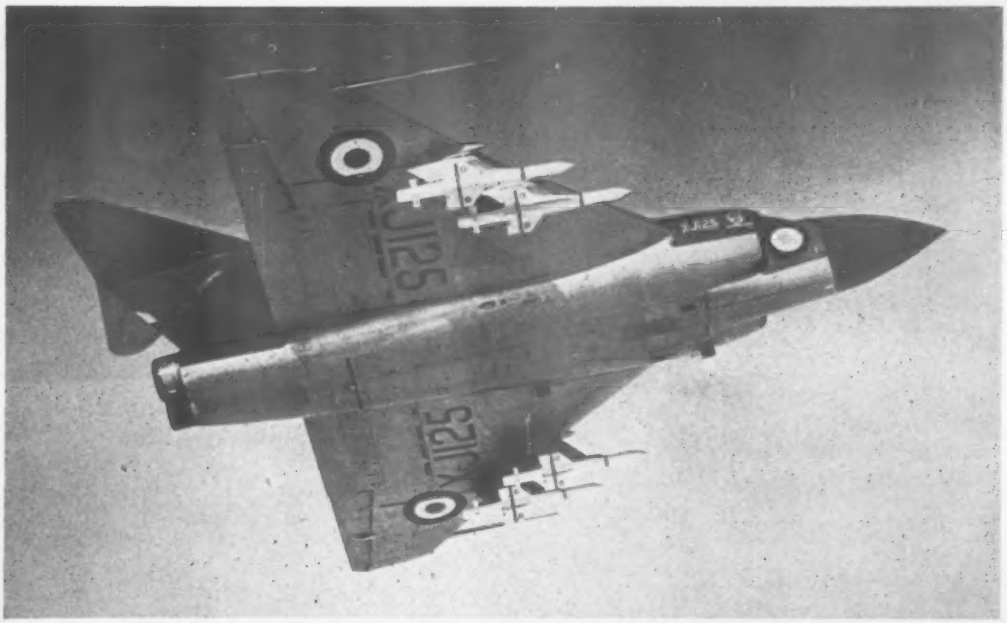
Right, the elegant lines of the Avon-powered two-seat Hunter trainer are seen to advantage in this view.



Farnborough First Report . . . .

Right, Handley Page's Dart Herald, recently back from a South American tour, displays its relatively high aspect ratio wing.

Below, the Javelin FAW 8 displayed is a standard production version carrying four Firestreak air-to-air missiles and powered by Sapphires.



Below, a low-level strike aircraft for the Royal Navy, the Blackburn NA.39 has two de Havilland Gyron Junior turbojets and can deliver an atomic weapon.

Farnborough

First Report . . . .

Powerplant Newcomers

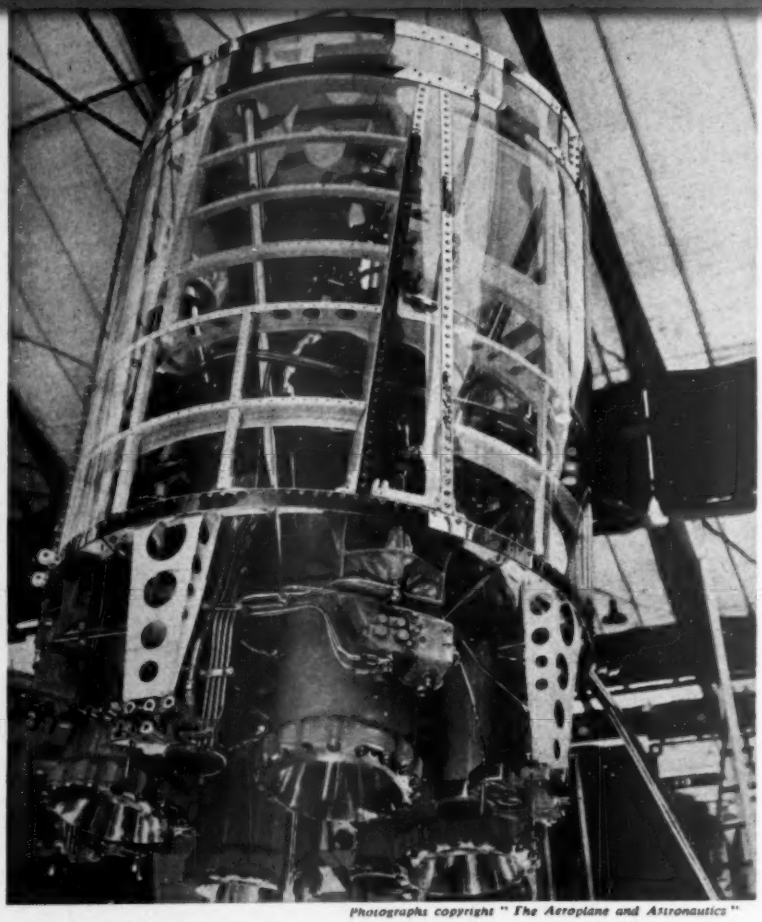
—and notes on the 33 engine exhibits

Avon RA.29.—Rolls-Royce, Ltd. Civil Avon for the Comet 4; 10,500 lb. thrust. Overhaul life now 1,300 hr. and 1,600 hr. on trial basis. Engine shown is from B.O.A.C. Comet 4 and has run 1,600 hr. since last overhaul. First ran March, 1956. Type test March, 1957.

Avon RB.146.—Rolls-Royce, Ltd. First showing of latest military Avon. Dry thrust, 13,220 lb. Apparently developed from RA.24 with additional compressor stage. Has air-cooled turbine blades. Shown with afterburner.

Blackburn A.129.—Blackburn Engines, Ltd. This free-turbine engine powers the Mk. 2 Saunders-Roe P.531 helicopter, which made its first flight on August 9. Initially rated at 840 s.h.p., it is to be type-tested at 970 s.h.p. later this year. First ran July, 1958, as turbojet and August, 1958, as shaft turbine.

Bristol Siddeley BE.58.—Bristol Siddeley Engines, Ltd. First public exhibition of an engine in this company's ducted-fan range. This front-fan civil powerplant gives 14,500 lb. thrust for take-off at s.f.c. 0.572 lb./lb./hr. Weight, 2,600 lb. Typical cruise s.f.c. at 36,000 ft., 0.8 lb./lb./hr. Thrust: Weight ratio is 5.58:1.



Photographs copyright "The Aeroplane and Astronautics"

Bristol Siddeley's Gamma rocket engine for Black Knight—on show for the first time.

Bristol Siddeley PR.23.—Bristol Siddeley Engines, Ltd. Small HTP/kerosene rocket motor with thrust controllable between 166 and 500 lb. (at sea level). Weight, 32 lb. Possible applications as ballistic-missile vernier motor and for missile and aircraft propulsion and control.

Conway RCo.10.—Rolls-Royce, Ltd. Engine as installed in Boeing 707-420 with thrust reverser and silencing nozzle. Guaranteed minimum take-off thrust recently uprated—ahead of schedule—to 17,500 lb. RCo.22 under development to give guaranteed minimum thrust of 20,250 lb. First ran July, 1957. Type test July, 1958.

Double Spectre DSpe. D.1.—The de Havilland Engine Co., Ltd. Powerplant of Avro Blue Steel ASM. Fixed-thrust Spectre 4 HTP/kerosene rocket motor mounted above variable-thrust Spectre 5. Total thrust 16,000 lb. First ran September, 1958.

Eland NEl.6.—D. Napier and Son, Ltd. Cutaway display version of the NEl.6 which powers the Canadair 540. First ran (NEl.1), August, 1952, and type-tested May, 1956.

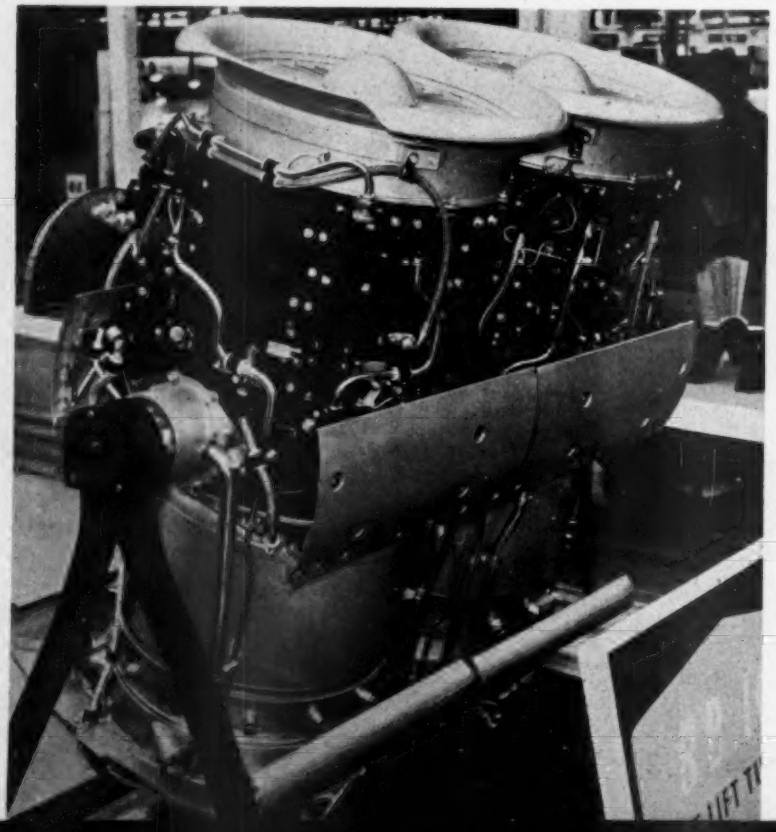
Eland 504.—D. Napier and Son, Ltd. Shown as complete power pack ready for installation in Canadair 540 transport. NEl.6 engine delivers 3,500 e.h.p. for take-off. Blackburn Palouste air compressor in power pack supplies air for engine starting and warming oil coolers. First ran June, 1956. Type test February 1958.

Gamma 201.—Bristol Siddeley Engines, Ltd. First showing of the four-chamber HTP/kerosene rocket engine which powers the Black Knight re-entry research vehicle. Thrust, 16,400 lb. rising to 19,000 lb. above the atmosphere. Based on single-chamber Gamma developed by R.A.E., Westcott. First ran August, 1956. Type test October, 1957.

Gazelle NGa.2.—D. Napier and Son, Ltd. Sectioned display version of the 1,800 s.h.p. free-turbine engine installed in Bristol 192 and Westland Wessex military helicopter. First ran December, 1955. First gas-turbine engine to receive M.o.S. 150-hr. helicopter type approval—at 1,650 s.h.p.—September, 1959.

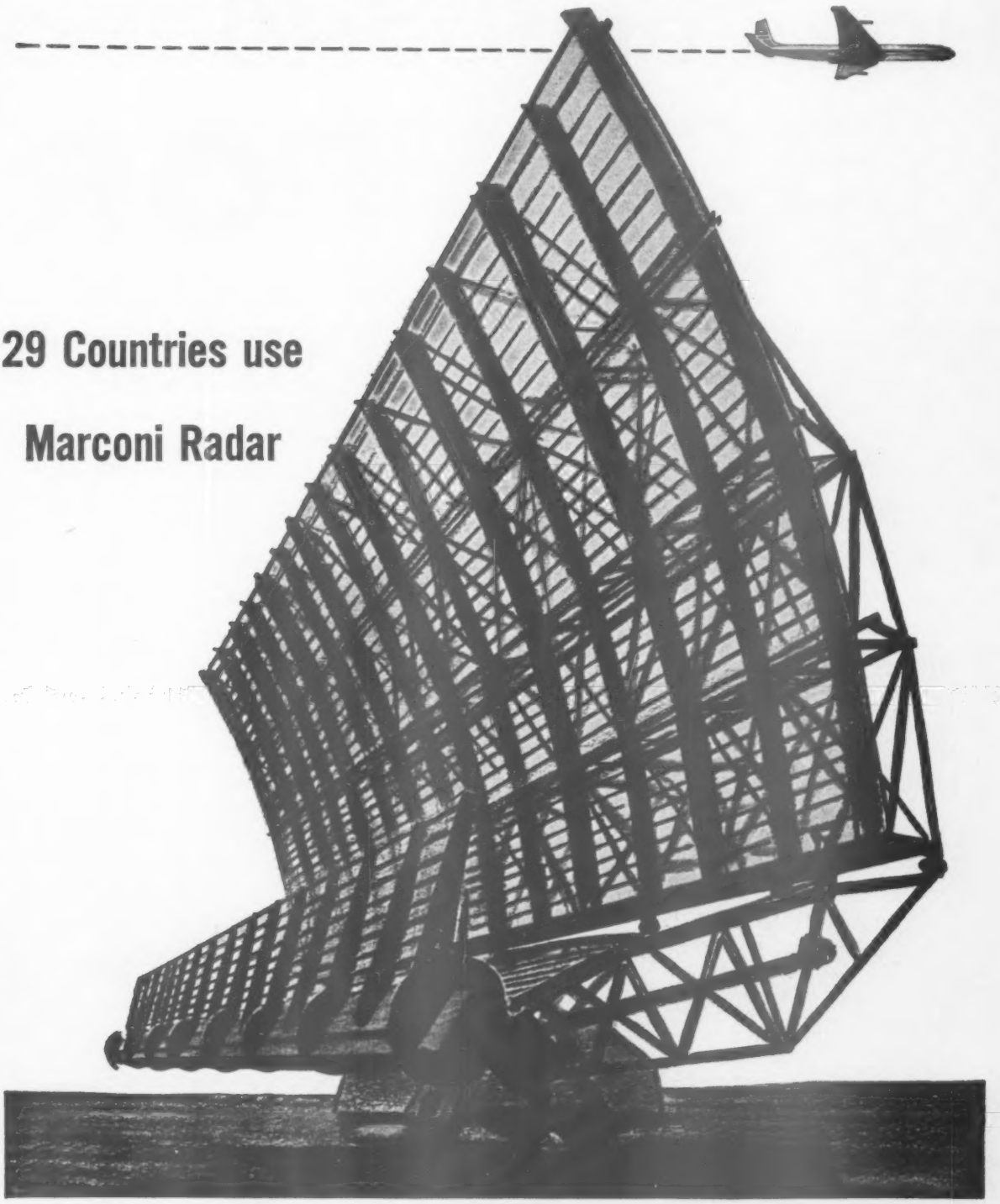
Gipsy Major 215.—The de Havilland Engine Co., Ltd. Installation of engine and turbo supercharger as in Saunders-Roe Skeeter helicopter; 220 b.h.p. sea-level performance can be maintained up to 4,000 ft.

(*Continued on page 189*)



Another powerplant newcomer is this Rolls-Royce RB.108 paired unit—half of the SC.1's lifting powerplant.

Marconi in Radar



29 Countries use Marconi Radar

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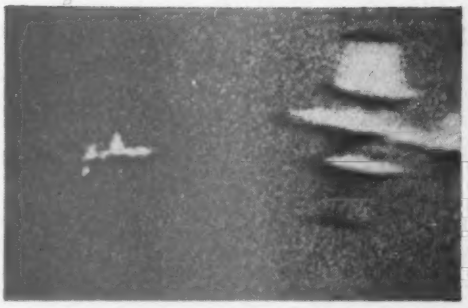
Surface-to-air guided missiles represent the most important advance in defence against air attack since aerial aggression began. These unmanned interceptors are not committed to a predetermined course, but, even after launching, take corrective action against target aircraft evasion.



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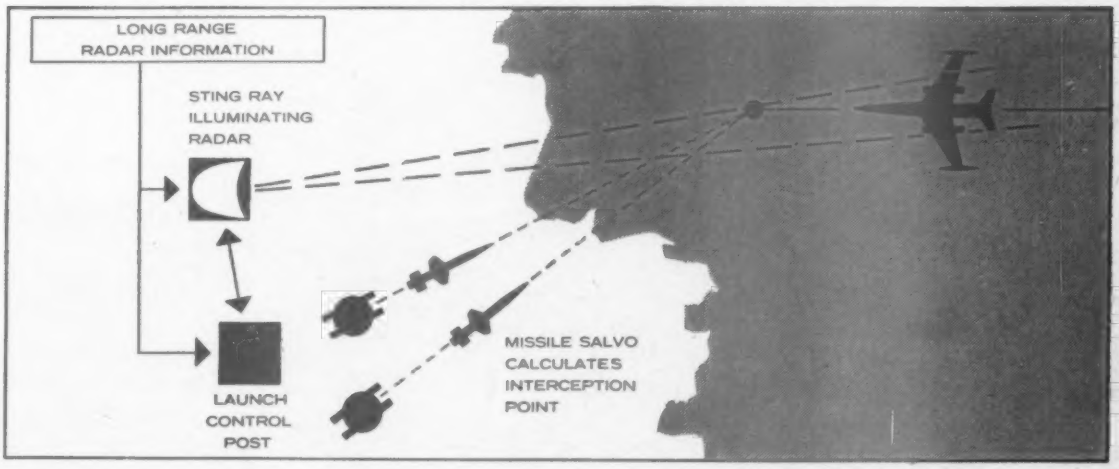
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ground starting and airborne auxiliary services

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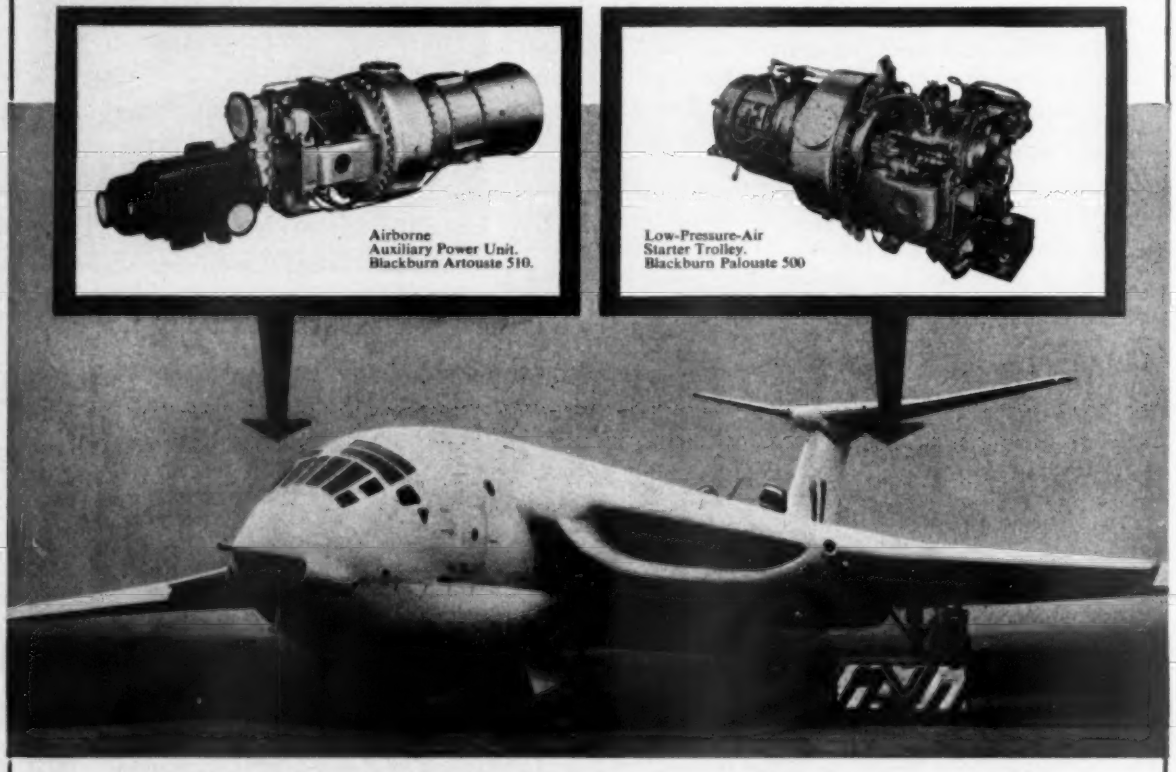

Airborne Auxiliary Power Unit. Blackburn Artouste 510.

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The Fighting Services

Air Rank Appointments

AIR VICE-MARSHAL D. J. P. LEE, C.B., C.B.E., became Commander, Air Forces, British Forces, Arabian Peninsula, last month. Secretary of the Chiefs of Staff Committee, Ministry of Defence, since April, 1956, he formerly commanded R.A.F. Scampton. Air Vice-Marshal C. D. Candy, C.B.E., R.A.A.F., has been appointed Senior Air Staff Officer, F.E.A.F., and Air Vice-Marshal P. S. Blockey, C.B., C.B.E., became S.A.S.O., Technical Training Command, on August 24. A.V.M. Candy was previously A.O.C., R.A.A.F. Home Command, and A.V.M. Blockey has been Director-General Aircraft Research and Development (R.A.F.) at the Ministry of Supply since 1956.

Two other recent Air Vice-Marshal appointments are those of Air Cdre. H. J. Maguire, C.B., D.S.O., O.B.E., who became Senior Air Staff Officer at Fighter Command on August 28, and Air Cdre. C. H. Hartley, C.B.E., D.F.C., A.F.C., who has been appointed A.O.C., No. 12 Group, Fighter Command. Air Cdre. Maguire was previously S.A.S.O. at No. 11 Group and Air Cdre. Hartley has been S.A.S.O., No. 12 Group, Fighter Command, since August, 1958.

Air Cdre. B. D. Nicholas, C.B.E., who has been Commandant of the Central Signals Establishment at R.A.F. Watton since 1957, has taken up the Ministry of Supply appointment of Chairman of the NATO Electronic Warfare Liaison Committee.

Gp. Capt. W. Bayley, M.B.E., Deputy Director of Technical Training at the Air Ministry since last February, recently became Director of Air Engineering, with the acting rank of Air Cdre. Gp. Capt. W. V. Crawford-Compton, C.B.E., D.S.O., D.F.C., who since January, 1957, has been instructing at the school of Land/Air Warfare, has become Senior Air Staff Officer, No. 11 Group, with the acting rank of Air Cdre.

The Queen's Flight

TWO appointments to the Queen's Flight at R.A.F. Benson have recently been announced.

Gp. Capt. T. N. Stack, A.F.C., has become Deputy Captain, and Wg. Cdr. R. G. Wakeford, O.B.E., A.F.C., has been appointed Commander of the Flight. Gp. Capt. Stack has been Group Captain in charge of Operations (Transport Support) at Headquarters, Transport Command, since 1957. Wg. Cdr. Wakeford, who last year undertook a course of all-weather jet flying at the R.A.F. Flying College, Manby, was seconded to the Malayan Government in 1957 as Director of Operations.

The Captain of the Flight is Air Cdre. Sir Edward Fielden, K.C.V.O., C.B., D.F.C., A.F.C.

Search and Rescue Trophy

A SILVER cup—known as the Suphan Trophy—is to be awarded annually by M.E.A.F. for the best individual or team feat of search and rescue undertaken during operations or training in the Command, or by search forces operating under its control.

The trophy is named after the mountain in eastern Turkey which the R.A.F. Mountain Rescue Team from Cyprus climbed, under most hazardous conditions, to reach the wreckage of a British Tudor aircraft which crashed while flying to Australia. In recognition of its part in the operation, the R.A.F. Cyprus Mountain Rescue Team will hold the trophy for the first year. It is being bought with part of a sum of money presented to the Command by Air Charter, which owned the Tudor; the rest of the money has been given by M.E.A.F. to the R.A.F. Benevolent Fund.

Individuals winning the trophy will have their names engraved on it. If a team wins it, the team leader's name will be inscribed. In recognition of the help during the Suphan operation, a replica of the trophy is to be presented to the Turkish Air Force.

Far East Defence

ALL-WEATHER fighters in the form of Armstrong Whitworth Meteor NF.14s are shortly joining the various types operating with the Far East Air Force. This is the first occasion that such aircraft have been sent to serve with the Command and will, presumably, be replaced by one of the later marks of Javelin sometime in the not too distant future.

Crews for the NF.14s have recently completed their all-weather training at R.A.F. Leeming and are in the process of moving out to Singapore where they are being posted to R.A.F. Tengah to join No. 60 Squadron. This Squadron, at present operating D.H. Venom FB.4s, is to become a complete all-weather unit under the command of Sqn. Ldr. R. Knight, the C.O. designate. Until sufficient night-fighters arrive for the full change-over, it will comprise a flight of day fighters and a flight of night fighters.

SQUADRON TROPHIES.—As recorded on this page, No. 60 Squadron has recently been presented with two new trophies. Air Chief Marshal Sir Claude Pelly (centre) is seen handing over the silver model of a Hurricane 2c to Sqn. Ldr. R. Knight, the C.O. designate, while Air Cdre. W. Wynter-Morgan holds the model Meteor NF.14 which he presented on behalf of Armstrong Whitworth Aircraft.

A day fighter/ground attack unit for many years, No. 60 Squadron previously operated Venom FB.1s and Vampire FB.9s on bombing and strafing sorties over Malaya, as well as interception exercises with the Singapore local sector radar controllers. This change in rôle will bring about a completely new chapter in the Squadron's history and to mark the event, the No. 60 Officers' Dinner Club recently held a small party in London to meet the new "all-weather" members. At this gathering a model of a Meteor NF.14 was presented to Sqn. Ldr. Knight by Armstrong Whitworths, and Air Chief Marshal Sir Claude Pelly, on behalf of the Dinner Club, gave a silver model of a Hurricane 2c to the Squadron.

R.A.F. Appointments

THE following are among recent Royal Air Force appointments:—

Air Ministry: Gp. Capt. J. E. Allen-Jones, O.B.E., to the Department of Legal Services; Wg. Cdr. J. F. Roberts, D.F.C., D.F.M., Wg. Cdr. J. I. Parker and Wg. Cdr. D. B. Delaney, A.F.C., to the Department of the Chief of the Air Staff; Wg. Cdr. T. J. Goggin to the Department of the Air Member for Supply and Organization; Sqn. Ldr. J. A. Kennedy, D.F.M., to the Department of the Chief of the Air Staff.

Fighter Command: Sqn. Ldr. S. L. Gordon to Headquarters with acting rank of Wg. Cdr.

Coastal Command: Sqn. Ldr. A. C. Davies to R.A.F. St. Mawgan to command No. 201 Squadron, with acting rank of Wg. Cdr.

Flying Training Command: Wg. Cdr. W. R. Williams, O.B.E., D.F.C., to Headquarters as Officer Commanding Air Element of the Combined Cadet Force, with acting rank of Gp. Capt.; Wg. Cdr. J. Rayson, A.F.C. to R.A.F. Topcliffe as Chief Navigation Instructor.

Maintenance Command: Wg. Cdr. A. J. Sansom to Headquarters for accounts duties; Wg. Cdr. F. T. Solis to Headquarters as Deputy Senior Personnel Staff Officer. Wg. Cdr. S. V. Perry, O.B.E., to Headquarters.

Signals Command: Wg. Cdr. A. O. Forth to Headquarters as Wing Commander, Operations; Wg. Cdr. R. G. Seymour to R.A.F. Digby, Lincoln, to command.

R.A.F. Germany: Sqn. Ldr. J. G. Pearse to R.A.F. Sundern to command, with the acting rank of Wg. Cdr.

Far East Air Force: Gp. Capt. W. E. Wolsey, C.B.E., to Headquarters as Command Accountant.

Other Appointments: Wg. Cdr. W. Harbison, A.F.C., to the British Joint Services Mission, Washington, D.C., for fighter operations duties; Wg. Cdr. E. W. Merriman, M.B.E., D.F.M., to the U.S. Armed Forces Staff College, Norfolk, Virginia, as student; Wg. Cdr. R. F. B. Powell, A.F.C., to R.A.F. Idris, Libya, to command; Wg. Cdr. R. L. Wade, D.F.C., to R.A.F. Luqa, Malta, to command No. 39 Squadron.

Reunion

M.R.E.S. Officers.—The 11th reunion will be held in London on October 31, 1959. For full particulars write, enclosing stamped, addressed envelope, to Sqn. Ldr. P. E. Laughton-Bramley, 18 Cadogan Place, London, S.W.1.

Tenth I.A.S.

Mr. Aubrey Jones, at the opening.

NOTHING is stranger than the evaluations by the daily Press of any given event. From the headlines, or the lack of them, the people of this country might be excused for ignorance of the opening in London on August 31 by Mr. Aubrey Jones, Minister of Supply, in Church House, Westminster, of the Tenth Congress of the International Astronautical Federation which represents the astronautical élite of 30 nations. But whatever the evaluation by the public of this country, there was no doubt about the international interest. Instead of the 200 delegates who had registered, numbers rose rapidly until the organizers were talking of 700 registrations.

In such circumstances, the circular conference hall of Church House was well filled when Dr. Shepherd, chairman of the B.I.S., the host society, rose to address members. Mr. Andrew Haley, president of the I.A.F., the author of an instructive article in THE AEROPLANE AND ASTRONAUTICS last week, had some practical proposals to make.

He proposed that the member societies should authorize the setting-up of a permanent secretariat for the I.A.F. and also the creation of an International Academy of Astronautics. He then proposed the creation of a Commission, within the new Academy, composed of nine representative scientists who should formulate a programme for a number of working parties to process and adapt the scientific knowledge and inventions gained in the astronautics effort into applications of immediate benefit to mankind. He also proposed the creation of a Commission within the Academy on the codification of the law of outer space. His third proposal concerned the creation of a Commission within the Academy on the encouragement and co-ordination of astronautic research and development within nations which do not have the resources to provide their own facilities. At a later stage the I.A.F. Council duly agreed that such an Academy should be brought into being.

It was noteworthy that in his speech to open the Conference, Mr. Aubrey Jones concerned himself with the link between political powers and scientific investigation. In other words, he treated his audience to a discussion of whether there was any justification for Government support of astronautical effort. Of the British Government's intention to participate in an international effort he said not a word.

However it has to be said that his audience, or the British members at any rate, were relieved that after marshalling the arguments against space research, Mr. Jones was able to say that he was not impressed by them. He then advanced a positive argument for space research, namely the possibility of making observations outside the Earth's atmosphere. He was not prepared on that scientific occasion to discuss what proportion of the U.K.'s resources should be allocated to such work. From a scientific standpoint, however, he said there was doubt that every State claiming to be civilized should do all it can to encourage advances in the knowledge of the physics, chemistry and even the biology of space.

Space Exploration Today

Dr. Hugh Dryden, in his address to the Conference, had no doubt that the task of this generation is to advance the exploration of space as much as it can. Dr. Dryden, known and admired in aeronautical circles in this country for many years, is now Deputy Administrator of the U.S. National Aeronautics and Space Administration. This is the civilian body which has developed from the internationally known and admired civilian U.S. National Advisory Committee for Aeronautics, which Dr. Dryden led for so many years.

After a brief historical survey Dr. Dryden said the exploration of space by unmanned vehicles carrying scientific apparatus began on October 4, 1957; exploration by man will follow in due course.

The present stage of development of vehicles for space exploration corresponds, he said, to some degree to that of the aeroplane in 1905. We find it as difficult to predict the pace and scope of developments in space exploration now as it was then to foresee the amazing developments in performance and utility of the aeroplane which have since come to pass. But there are important differences. In 1905 it was possible for an individual to learn all that had been discovered about aeronautics and aircraft design. Aeroplanes were designed by individual inventors or engineers. This situation soon changed.

Today there is no single designer of a modern aeroplane; it represents the work of many specialists organized into an effective team and its design is based on the contributions of many men of past and present generations. The development is supported by an extensive research programme in the basic aeronautical sciences. In fact, the development of a modern supersonic aeroplane is a task commensurate with the technical and financial resources of a whole nation rather than with those of a single private company.

"I do not foresee," continued Dr. Dryden, "any projects in space exploration similar to Lindbergh's flight across the ocean. For the present only a few nations are able to undertake a comprehensive programme of space exploration. There is every indication that the task may soon develop beyond the resources of any single nation. The incentives to international co-operation thus transcend those which led to world-wide collaboration in the exploration of space by astronomical methods. Even at the present stage the global aspects of space exploration demand some degree of international co-operation."

One of the principal objectives of current space activity is the study of the space environment by the conduct of scientific experiments using apparatus carried by sounding rockets, man-made earth satellites, man-made planets, and deep space probes.

The NASA programme for the future, and presumably those of other countries, looks to the orderly development of increased capabilities which permit the more and more detailed study of the space within our solar system and of the Moon and planets. Already space probes have been sent to distances beyond the Moon and the miss distance will decrease as development of vehicles and guidance proceeds. In due course artificial satellites of the Moon will be established, followed by hard and soft landings of scientific equipment on the lunar surface. In similar fashion the nearer planets, Mars and Venus, will be studied when the requisite vehicle systems are available.

Manned Exploration of Space

The NASA objectives include the investigation of the uses of earth satellites to perform more efficiently and effectively some tasks which are now carried out by other means and to perform other tasks which cannot be done at all with present means. The applications which seem most promising at present are to weather observation, analysis, and forecasting on a global scale; to the improvement of long-distance radio communication; to the study of the size and shape of the Earth and of the distribution of land masses and water; and to all-weather global navigation.

It is believed that such applications brought to successful fruition will further the welfare of mankind everywhere.

NASA has an active project under way for a simple form of communication satellite which can be used by any nation or person having the necessary ground equipment without interference with any other user. It is well known that the Moon may be used as a reflector of radio and radar signals if very powerful transmitters and very sensitive receivers are used on the ground and the geometrical relations are correct. Satellites can provide smaller moons nearer the earth which require less transmitter power and less expensive equipment. According to some studies a passive satellite system may prove economically competitive with ocean cable for transatlantic communication. Television or other wide band transmission would be possible over this system.

The NASA programme objectives, presumably like those of other countries, include the orderly development of means for the manned exploration of space. En route to the long-range objective of manned exploration of the solar system are the temporary ballistic flight of man into space and return (already accomplished with animals), orbital flight for one or a few circuits in the simplest vehicle below the level of the Great Radiation Belt, manned flight in advanced manœuvrable vehicles, in larger satellites carrying several men, in permanent manned orbiting space laboratories, manned flight to the vicinity of the Moon and return to Earth, and manned landing on the Moon and return.

Even the first steps in the manned exploration of space are

(*Continued on page 174*)

Congress Opens in London

(All photographs copyright "The Aeroplane and Astronautics" except that at top right.)

U.S. DELEGATES.—Left to right, Mr. McDuffee, Dr. M. E. Smith (Rand Corp.), Major Kennedy, Colonel Latham.

Dr. L. R. Shepherd, chairman of the British Interplanetary Society shows a model of Blue Streak satellite concept to Dr. T. C. Helvey of Radiation Inc. (U.S.A.)

Left, M. Poggi of the French Astronautical Society with Mr. Petropoulos, the secretary of the Greek Astronautical Society.

Mr. T. Szekely, General Electric Aircraft Nuclear Propulsion Project, and Mr. R. F. Gompertz, N.A.A. Rocketdyne Division.

Mr. A. V. Cleaver, Rolls-Royce, and Dr. I. M. Levitt, Fels Planetarium of Franklin Institute.

Dr. Dryden, deputy administrator of NASA, with Mr. K. W. Gatland, B.I.S. Vice-chairman.

RUSSIAN DELEGATES.—Mr. K. Ogorodnikov, Professor L. I. Sedov, Vice-president I.A.F., and Mr. Krassovsky.

Dr. E. T. Jones, M.o.S., Mr. J. E. Allen, A. V. Roe & Co. Ltd., Dr. W. F. Hilton, Hawker Siddeley Aviation, Ltd.

(*Continued from page 172*)

very expensive as may be inferred from the estimated cost of Project Mercury of $200 million or more. The resources required for the advanced missions may well demand a world-wide collaboration and serve to give a true measure of man's response to the challenge to discover and explore the new frontier of our day.

According to testimony before Congressional Committees in defence of the U.S. budget estimate for the period July 1, 1959, to June 30, 1960, the total estimate for the aeronautical and space activities of NASA amounted to approximately $500 million.

There is of course much research essential to activities of the type described but carried out on the ground with the aid of suitable equipment for simulating various aspects of the vehicle or space environment. As in many branches of science and technology, contributions will come from a large number of countries by groups without direct access to space vehicles.

After discussing in some detail the possibilities for international collaboration Dr. Dryden concluded that when one considers the vast distances of the solar system—93 million miles to the Sun; 26 million miles to Venus, the nearest planet; 3,680 million miles to Pluto—and when one catalogues the problems to be solved and the new knowledge needed in almost every branch of science and technology from magnetohydrodynamics to cosmology, from materials to biology and psychology, the magnitude of the task before us becomes apparent. It is a task that challenges the peoples of the Earth as a whole. There is room for co-operation of men of many skills and of nations large and small.

Kenneth Gatland Reports on

Manned Satellites and Hypersonic Gliders

PRACTICAL advantages of using large desert areas in Talgarno, between Broome and Port Hedland in N.W. Australia, were put forward at the Commonwealth Spaceflight Symposium. They would, for instance, be ideal for the recovery of satellite capsules descending from orbit.

The exact point of impact of these non-lifting bodies may be difficult to predict with great accuracy. Mr. H. J. Higgs, Australian representative of the W.R.E. in London, pointed out that the Australian desert would provide a "recovery area" roughly the size of France.

These discussions were continued at the 10th I.A.F. Congress when several U.S. delegates expressed interest in the Woomera range facilities, both from the viewpoint of satellite capsule tracking and recovery.

It seems fairly obvious that recovery on land is a better proposition than either the American air-snatch technique, using patrolling aircraft, or the detection and recovery of capsules from the open sea. Thus it seems Woomera—and particularly the area of Talgarno—could make immediate contribution to World astronautics, which could effectively strengthen our present rather superficial position in space research.

An important factor in considering Woomera for this purpose is that the Australian range is already liberally endowed with tracking and communication equipment, and providing a reasonably precise ejection from orbit is accomplished, it should be possible to locate a returning capsule without much difficulty. This is particularly relevant to the biological satellite, where test animals have to be retrieved from the fallen capsule in the shortest possible time.

Development of Woomera as a satellite launching station also appears practicable. One delegate suggested that the Australian range could become as important as Cape Canaveral or Vandenberg. The enormous cost of developing new launching sites, and the rising number of space-experiments, will mean that the World's test ranges will be at a premium in the years ahead.

As Mr. H. J. Higgs had explained earlier, there should be no great difficulty in establishing range corridors lying due north or to the north-east of Woomera. The present range for ballistic missile launching is angled to the north-west, against the direction of the Earth's rotation, and therefore is unsuitable for satellite launching.

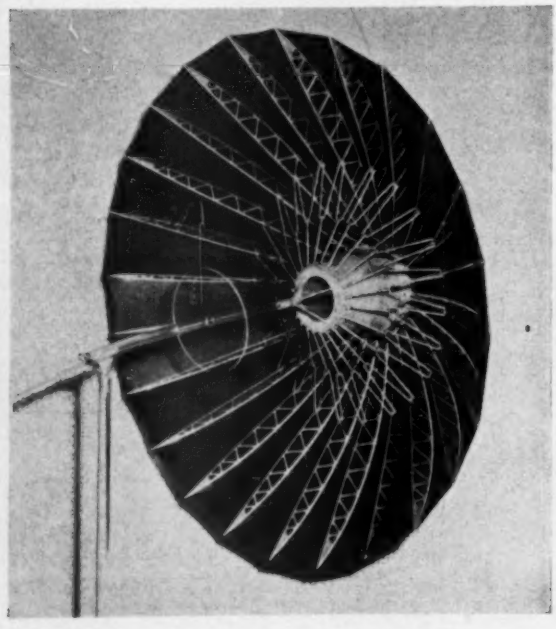
Wings or Drag Brakes?

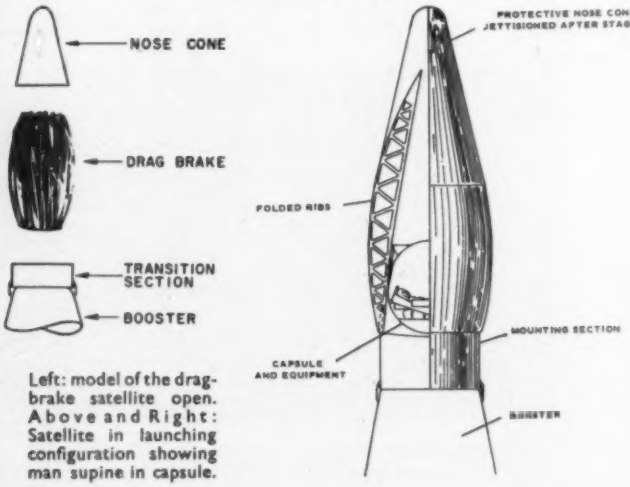
A major talking point at both conferences was the respective merits of the various concepts of manned satellites, broadly defined as non-lifting, variable-area and winged.

British delegates favoured winged vehicles and a re-entry which could be controlled, an outlook admirably presented by Dr. W. F. Hilton in his Congress paper on "Re-entry paths for manned satellites," which was related to Mr. H. R. Watson's Commonwealth Symposium paper on the Armstrong Whitworth "pyramid" vehicle. (THE AEROPLANE AND ASTRONAUTICS, August 28, 1959, p. 51.)

"The ultimate use of aerodynamic lift will make the zero-lift vehicles as out of date as aeroplanes have made balloons," suggested Dr. Hilton. "The important advantage of a lifting re-entry vehicle is the possibility open to the pilot of landing anywhere over a large area of the Earth's surface. The point of impact of a non-lifting re-entry vehicle, on the other hand,

(*Continued on page 175*)





Left: model of the drag-brake satellite open. Above and Right: Satellite in launching configuration showing man supine in capsule.

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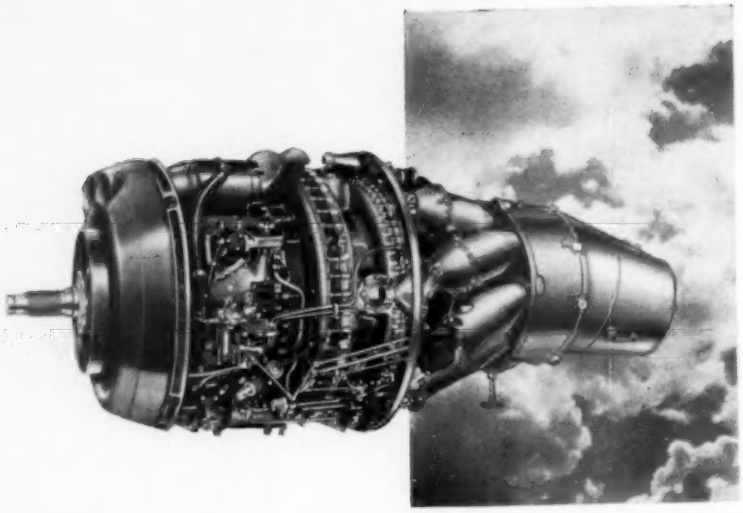

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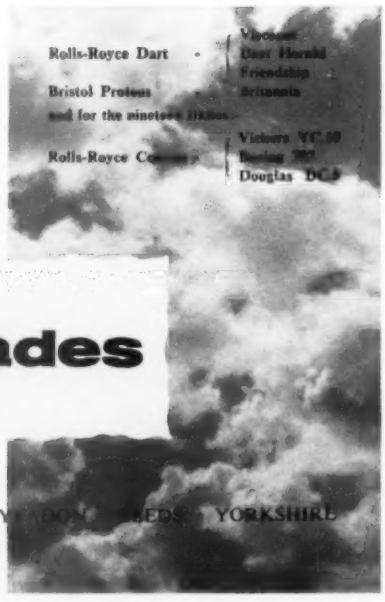

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(*Continued from page 174*)

is entirely determined once it plunges into the atmosphere at sub-orbital speeds."

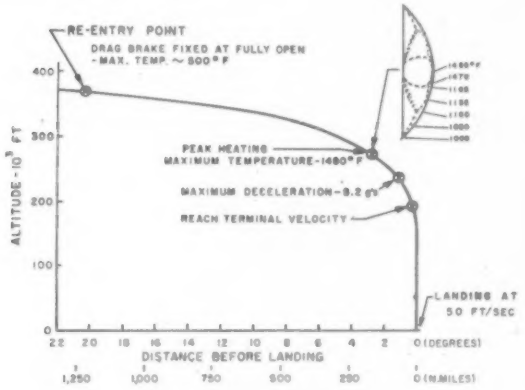
"Parasol" Satellite

Despite British enthusiasm for winged re-entry vehicles, general approval was expressed by delegates for the "second generation" satellite capsule designed by the Avco-Everett Research Laboratory, AVCO Corporation, Massachusetts. Details of the project were given in the paper "The Drag Brake Manned Satellite System" by R. W. Detras, A. R. Kantrowitz, F. R. Riddell and P. H. Rose.

The novel feature of the AVCO design is a variable-area drag brake, which has the appearance of an inverted parasol when fully opened. The parasol drag brake actually surrounds the life-compartment of the satellite, and opens and closes to achieve an optimum programme of deceleration.

Inside the nose-cone of the launching rocket, the drag brake is folded around the life-compartment. The human occupant lies supine on a contoured couch inside the capsule. The supporting ribs and flexible skin of the drag brake are folded inboard between the ribs.

Development of a reliable folding system has been a major problem, but the designers now feel that this has been largely solved. The covering material, fabricated in three layers, consists of stainless steel cloth made of .001 in. 400 x 400 mesh, a layer of .0005 in. stainless steel foil cut into circumferentially aligned ribbons, and finally another layer of mesh of coarser grade. Ground tests have shown that this structure, supported by light-gauge stainless-steel ribs, will accommodate all the air loads and kinetic heating likely to be encountered during



Curve showing heating and deceleration of drag-brake satellite from re-entry point to landing.

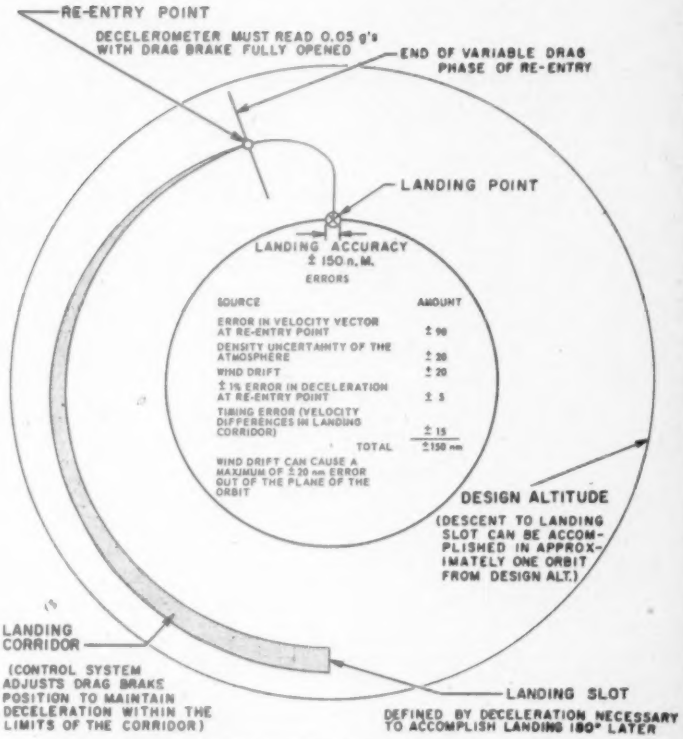
re-entry. These assertions aroused a good deal of discussion, not unnaturally.

In the launching rocket, the folded drag brake and capsule centre-body is covered by a protective nose cap; this would jettison together with an emergency rocket escape device when the launching rocket has cleared the appreciable atmosphere.

The intention would be to launch the satellite into a 105 n. mile, near-circular orbit, which allows an orbital life-time of two days with the drag structure folded offering minimum drag, and also permits emergency recovery in two hours with the drag brake at maximum spread. No information was forthcoming concerning the alighting speed of 50 ft. per sec. though it was generally assumed that the AVCO inverted parasol would drop into the sea.

A special feature of the AVCO design is that the small amount of residual atmosphere exerts forces on the vehicle which, because of the shape and large drag area of the extended drag brake, are sufficient to bring about orientation of the vehicle with respect to the relative air-flow. The residual small amplitude oscillation, having a period of several minutes, is considered short enough to maintain parallel flight path orientation to the Earth's surface throughout the orbital period of about 90 minutes.

This self-orientation characteristic eliminates the need for an auto-stabilizer and the associated gas-jet controls necessary in the Mercury space-capsule, with clear gain in both simplicity and reliability.


RE-ENTRY POINT
DECELEROMETER MUST READ 0.05 g's WITH DRAG BRAKE FULLY OPENED
END OF VARIABLE DRAG PHASE OF RE-ENTRY
LANDING POINT
LANDING ACCURACY
± 150 n. M.
ERRORS
SOURCE
AMOUNT
ERROR IN VELOCITY VECTOR AT RE-ENTRY POINT ± 90
DENSITY UNCERTAINTY OF THE ATMOSPHERE ± 20
WIND DRIFT ± 20
± 1% ERROR IN DECELERATION AT RE-ENTRY POINT ± 5
TIMING ERROR (VELOCITY DIFFERENCES IN LANDING CORRIDOR) ± 15
TOTAL ±150 nm
WIND DRIFT CAN CAUSE A MAXIMUM OF ± 20 nm ERROR OUT OF THE PLANE OF THE ORBIT
DESIGN ALTITUDE
(DESCENT TO LANDING SLOT CAN BE ACCOMPLISHED IN APPROXIMATELY ONE ORBIT FROM DESIGN ALT.)
LANDING CORRIDOR
(CONTROL SYSTEM ADJUSTS DRAG BRAKE POSITION TO MAINTAIN DECELERATION WITHIN THE LIMITS OF THE CORRIDOR)
LANDING SLOT
DEFINED BY DECELERATION NECESSARY TO ACCOMPLISH LANDING 180° LATER

Re-entry sequence showing transfer from orbit to re-entry.

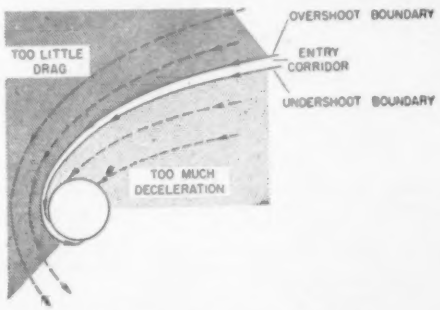
The Re-entry Corridor

In a related paper "On the Corridor and Associated Trajectory Accuracy for Entry of Manned Spacecraft into Planetary Atmospheres," Mr. D. R. Chapman of NASA stressed that the altitude of a re-entry corridor depends strongly on the vehicle weight, size and drag coefficient, but that the corridor width between its overshoot and undershoot boundaries is independent of these characteristics. The corridor width is much greater for vehicles with aerodynamic lift than for non-lifting vehicles (as Dr. Hilton illustrated graphically in his lecture). The guidance requirements on accuracy of velocity and flight path are therefore critical for successful re-entry.

The AVCO drag brake is an interesting example of how controlled re-entry can be achieved from a close-satellite orbit without the expenditure of energy. First, by manipulation of the drag brake, the satellite descends to the region where a controlled re-entry is to be made. Thereafter, the drag is controlled according to a pre-set programme for about half an orbit in order to achieve a given velocity vector at a particular point.

Finally, the drag brake is fixed in the open position at the onset of serious heating and the vehicle passes through the heating and deceleration peaks and achieves its terminal velocity, landing at 50 ft./sec. at sea-level. Parachutes are not required for final recovery.

Ideal or nominal drag variation with time can be established for the controlled drag phase of re-entry. A body-mounted accelerometer measures this drag and to the nominal



Entry corridor for manned spacecraft.

value desired. The control system can then sense whether the drag is correct, too high, or too low, and can produce signals which vary the drag-brake position by either pneumatic, hydraulic, or electrical means. An important factor is that the control system is capable of correcting the effect of ellipticity, altitude error at the start of the controlled phase, and errors in contemporary knowledge of density variations in the upper atmosphere.

From the re-entry point (as shown in the diagram) to final touchdown, no further functions are required. The maximum temperature encountered by the structure of the capsule nose is less than 1,500 deg. F., assuming an emissivity of 0.85.

The drag-brake surface, which can radiate from both the front and rear surfaces, never exceeds an equilibrium temperature of 1,200 deg. F. At peak heating, reached at an altitude of 270,000 ft., the deceleration is about 4 *g*. After peak heating the deceleration continues to increase and reaches 8.2 *g* at 233,000 ft. The time above 8 *g*. is approximately 20 sec., which is considered well within the established limits of human endurance.

A secondary feature of the design is that the large metallic drag surface presents an excellent target for radar tracking.

Weight estimates have suggested that the AVCO drag brake would have a total weight in orbit of 1,527 lb., which compares with about 2,200 lb. for a capsule of the Mercury type. Lightness and simplicity are the keynotes of the AVCO design. A retro-rocket system, on the other hand, requires a device to orient the vehicle, a retro-rocket with auto-stabilizer, a heat-shield, and a sequence of decelerating parachutes. The drag brake performs *all* these functions.

So far, no contract has been placed for the AVCO project, but the designers estimate a prototype vehicle could be constructed for launching by an Atlas missile within 18 months.

Hypersonic Flight

Boost-glide vehicles operating at hypersonic speed in the upper atmosphere have been a talking point with NACA and NASA engineers for some time. It has been suggested, for example, that the propellant consumption of a hypersonic boost glider can be less than that of a supersonic transport powered by turbojets over very great distances (e.g., half global).

Historically, Sänger and Bredt were among the first to realize the military importance of hypersonic vehicles(1). Messrs. A. J. Eggers, Jnr., H. J. Allen and S. E. Neice, on the other hand, produced a simple and interesting comparative analysis of the performance of ballistic missiles, skip-type vehicles, and glide-type vehicles.

At the 10th I.A.F. Congress, a paper by Mr. Angelo Miele "On the Flight Path of a Hypervelocity Glider boosted by Rockets," considered the flight of a hypersonic vehicle operating along a so-called equilibrium trajectory, that is, a trajectory such that the weight is balanced by the lift plus the centrifugal force due to the vehicle's motion parallel to the Earth's curvature.

By means of the indirect methods of the calculus of variations, Miele shows that the path which maximizes the range includes: (1) an initial sub-arc in which all the propellant mass is expended at the maximum burning rate of the boost engine, and (2) a final sub-arc in which the hypervelocity glider coasts at variable altitude and in such a way that, for each instantaneous velocity, the aerodynamic drag is a minimum.

The resultant trajectory is endowed with an important property; it is the "extremal" path (i.e., a solution of the Euler equations) associated with the following problem: "Given the initial mass and final mass, the initial velocity and the final velocity, *find the angle of attack programme* and *the burning programme* which maximize the range of a hypersonic boost glider."

Miele's paper offers an analytical proof of the properties associated with the path studied by Eggers and his associates(2). Numerical analyses show that a range of 6,000 miles can be achieved if a multi-stage rocket accelerates the glider up to a cut-off velocity of 14,000 m.p.h. at an altitude of 40 miles. The corresponding flight time is 40 minutes.

Clearly, before converting the present idealized flight paths into practical trajectories flown by actual vehicles, aerodynamic, structural and thermal problems must be solved. Nevertheless, Miele says, the idea of flying across the Atlantic in 40 minutes is so fascinating that an imaginative and concentrated attack on these problems is desirable and warranted.

(1) "A rocket drive for long range bombers," Bureau of Aeronautics, Navy Dept., Translation CGD-32, 1944.
(2) "A comparative analysis of the performance of long range hypervelocity vehicles," NACA T.N. 4046, Oct., 1957.

Mr. Miele is director of Astrodynamics and Flight Mechanics, Boeing Scientific Research Laboratories, Seattle, Washington, and his company's researches are supported by the Army Ballistic Missile Agency, Huntsville, Alabama. It is therefore tempting to suggest that these boost-glider studies may be closely related to Boeing's interest in the Dyna-Soar project and ABMA'S work with boosters.

The propellant economics of the project mentioned at the beginning of this review may be brought a little closer into focus when it is known that at the Rocketdyne test facility at Santa Susana, liquid oxygen at 1 cent per gallon is actually cheaper than water. Fuel is, of course, a trifle more expensive (3 to 4 cents per gallon, untaxed).

Rocketdyne said the reasons why higher-energy propellants were not being considered for the initial stages of the ARPA Saturn and NASA Nova space-booster projects were largely related to cost and reliabilty, a large fund of experience having been obtained with lox/RP-1 in the ballistic programme.

A problem now receiving attention is how to improve economics by recovering the boosters.

Space Conference Closes

ADDRESSING the closing session of the Commonwealth Spaceflight Symposium on August 29, Dr. L. R. Shepherd, chairman of the British Interplanetary Society, said that the success of the three-day conference had exceeded all expectations. Over 200 representatives of science and industry had attended. From the large number of excellent papers, there could no longer be any doubt that Britain and the Commonwealth were ready and able to make their contributions to World astronautics.

Earlier, Mr. E. Wall of the de Havilland Aircraft of Canada had complimented the British Interplanetary Society on the rôle it was playing in furthering the aims of space-research in the Commonwealth. Somehow, he said, we have got to obtain backing from the respective Governments to develop space-vehicles and facilities. Clearly, the initiative must come from the United Kingdom.

Dr. White of Mullard, Ltd., stressed the need for a modest beginning. Black Knight had cost a mere £5 million to develop and the rocket had been successful in all firings to date. We could not afford the American approach, and he thought the B.I.S. was the only organization qualified to appraise the whole field and put up a realistic proposal for consideration by Commonwealth Governments. Mr. Maurice Brennan agreed that an economic approach was possible, but said he would not dwell on the disparity that existed between our present spending on space-research and the amount, for example, that the country spent on tobacco.

Dr. W. F. Hilton drew attention to the way in which military aircraft development in America was being allowed to run down while work on space-flight was being run-up, to compensate. In this way, the skilled labour force was kept active in a highly stimulating and imaginative field closely allied to aeronautics. This had yet to happen in this country and he thought astronautical work would have to play a similar part over here if the excellent research and design teams we had built up, with such effort, were to remain intact. Mr. H. J. Higgs, W.R.E. representative (M.o.S., Australia), agreed that a space-programme would be important to the study of hypersonics in relation to aircraft research.

In the United States, Mr. Higgs continued, a civilian organization, the National Aeronautics and Space Administration, had been brought into being. He would like to see a British Commonwealth Space Authority set up on broadly similar lines, drawing upon the resources of the various member countries.

[One aspect of such a body is discussed in the editorial.—ED.]

Mr. G. K. C. Pardoe of de Havilland Propellers said that as a result of the Commonwealth Symposium, we were now aware of the extent of relevant work and facilities existing in Britain and the Commonwealth. He thought the B.I.S. might extract a summary of the technical proceedings and make this generally available.

Dr. Shepherd for the B.I.S. said that it was proposed to convene a second Commonwealth meeting, probably in 1961. Meanwhile a working party meeting of delegates would be held within the next few months to assess the outcome of the present symposium.

The industry, he said, had done an excellent job by indicating what could be done with existing facilities, and from this beginning bigger things would undoubtedly grow. He was convinced that a space-programme would develop from work on the Blue Streak LRBM.

He agreed that a Commonwealth Space Authority should be considered, but the support and collaboration of industry would be needed to persuade the respective Governments to participate and contribute the necessary funds.—K.W.G.

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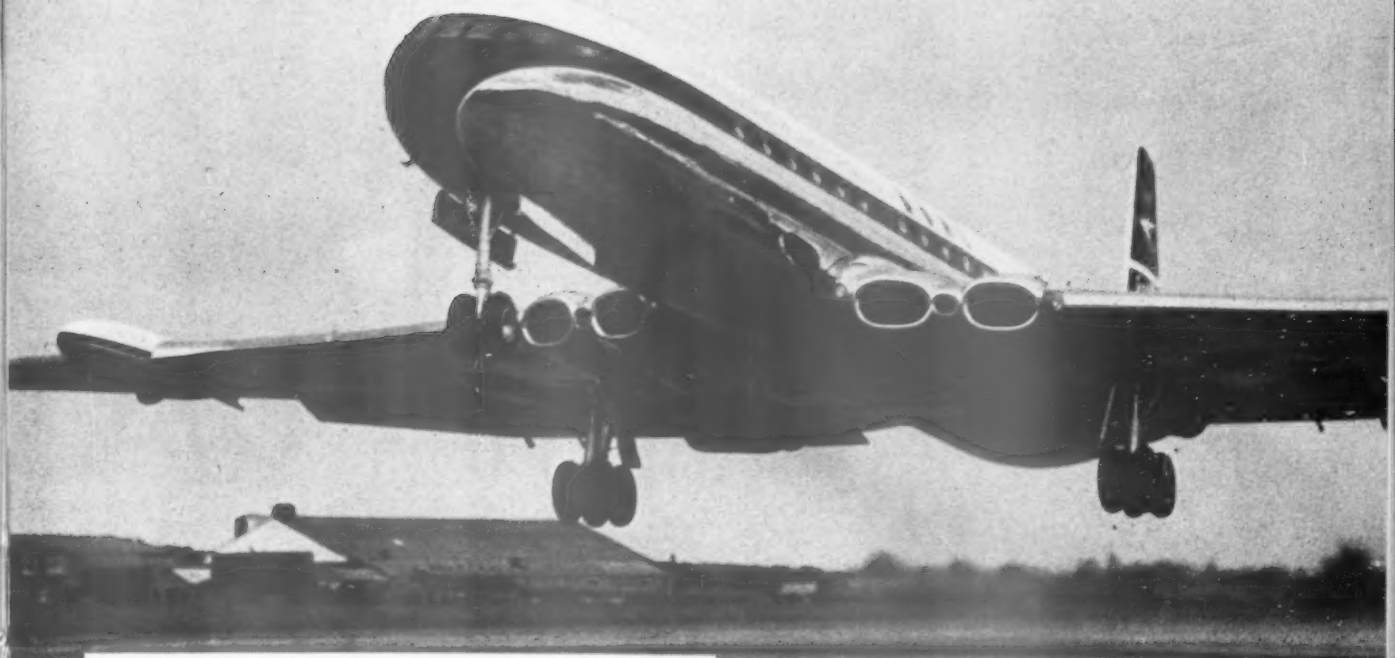

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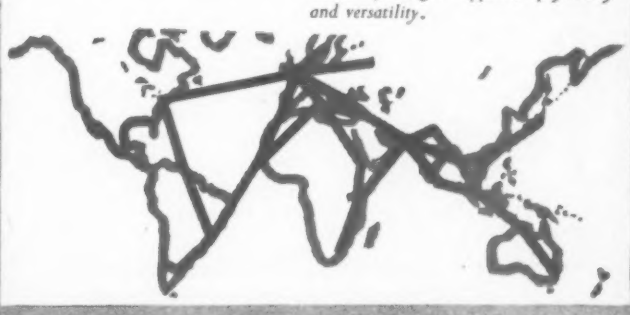

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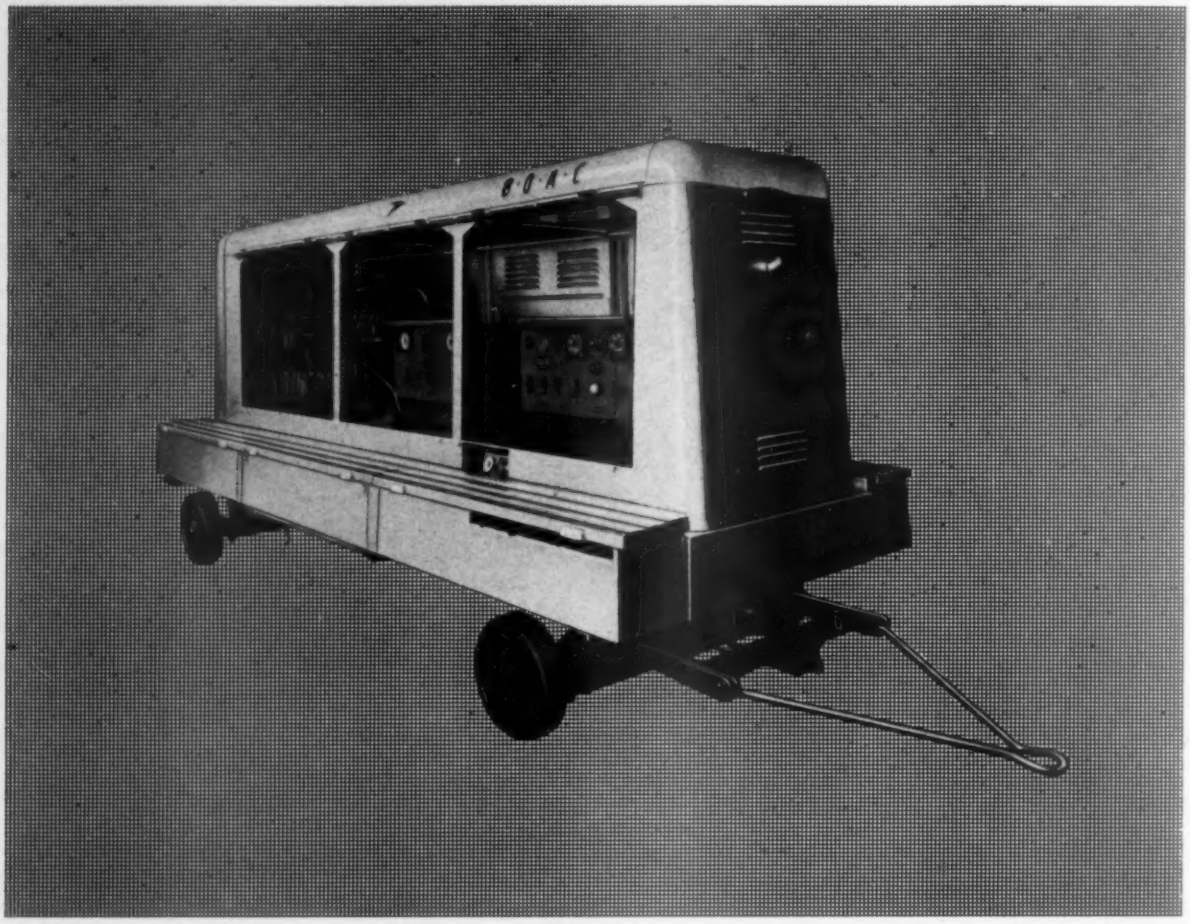

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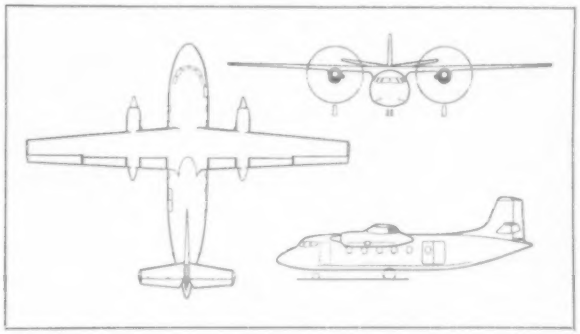
Made-to-Measure Feeder-Liner

The Avro 748 is the latest attempt to make a DC-3 replacement. The design philosophy, and some engineering details, are discussed here.

LESS than nine months after Hawker Siddeley Aviation decided to go ahead with the private-venture development of an Avro-designed feeder-liner, the company concluded an agreement for the sale of this aircraft to the Indian Air Force and its production in India. Moreover, the project has aroused the keen interest of many local service airlines, to the extent, in the case of Skyways, Ltd., of a " letter of intent " to purchase three; and the British Government has signified token support in the form of a £750,000 order for three more. This progress, with an aeroplane which falls squarely into the economically difficult and highly competitive category of a DC-3 replacement, can only be described as spectacular. What, then, are the ingredients of Avro's success?

The most direct answer to this question might be to say that the Avro 748 is a low-cost aeroplane backed by the resources —and the good name—of one of the most powerful groups in the British aircraft industry today. To undertake a project of this kind does not appear, at first glance, " the easiest and cheapest way " to re-enter the civil field with a private venture. Yet this is precisely what Avro set out to do. Close reasoning —and talks with the airlines—led inexorably to the cheap, 40-seat, twin-Dart feeder-liner as the right answer, despite the strength of the competition.

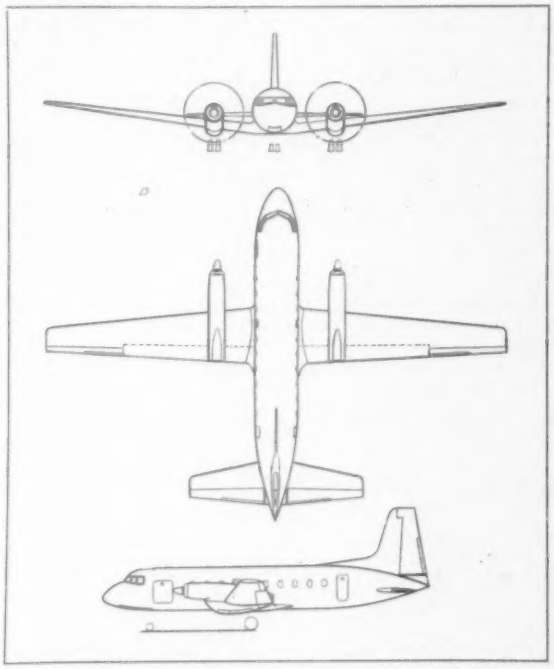
During 1957 (the Sandys White Paper on Defence was the catalyst) the Avro design team, under chief designer J. R. Ewans, made many design studies for various types of civil aircraft, of which feeder-liners in the general category of



Heron/Viking/DC-3 replacements seemed the most promising. The design features regarded as essential for a small feeder-line aeroplane were: a pressurized and air-conditioned fuselage; a cruising ceiling " above the weather "; a reduction in noise and vibration compared with current types; a higher cruising speed; more headroom in the cabin; and a modern standard of decor and seating. The first three of these features dictated the use of turboprop engines.

By the middle of 1958, the first project bearing the 748 type number had been drawn, and was for an 18,000-lb., 20-seat aeroplane with two 1,000 s.h.p. turboprops on a 75-ft.-span wing. A high-wing version was considered but was soon dropped in view of the known preference for a low wing among most operators, and also to make it easier to provide an uninterrupted cabin.

When this proposal was discussed with the airlines, in an extensive market survey conducted in Europe and South America a year or so ago, the company found that it was on the wrong track, especially so far as engines were concerned. There would, it was clear, be considerable difficulty in selling an aeroplane with engines by any manufacturer other than Rolls-Royce or Pratt & Whitney. To obtain the advantages of long overhaul periods and plenty of airline experience, the choice led naturally from here to the 1,600 s.h.p. Rolls-Royce Dart R.Da.6.



Left, the earliest Avro 748 project was an 18,000 lb. aeroplane with 1,000 h.p. turboprops. Above, the latest G.A. of the Avro 748 showing revised tailplane position, nacelle shape and port-side freight door.

This increase in power, which made the project considerably larger than at first proposed, was not altogether unacceptable, as it made it possible to consider a circular-section fuselage with four-abreast seating and an aisle wide enough for a cabin attendant—which many airlines said they wanted. The circular-section fuselage was best for low construction costs, and also lent weight to the arguments for a low wing. So, by the end of 1958, the Avro 748 had grown to its present size, and in this form the Hawker Siddeley Board authorized, in January of this year, the construction of four prototypes (two flying and two test specimens). The first metal was cut in February, at which time the target first-flight date was set for just one year later—in February, 1960.

Once the size of the project had been finally decided, consideration was given to other aspects of the design. In order

Avro have attractively furnished this specimen 748 front fuselage for display purposes, with new seats by Aircraft Furnishing at 36-in. pitch. The passenger service panels at each seat row slide to any position, in slots which are also the distribution ducts for cabin air.

to give customers the maximum flexibility, the fuselage has been designed as a shell, in which the whole interior above the cabin floor is free of equipment between the flight-deck bulkhead and the rear bulkhead, itself positioned as far aft as possible. The window pitch was set at 36 in. to provide windows for each seat row in the basic 40-seat arrangement.

Airfield performance was recognized to be of prime importance, and the company set out to match the Type 748 to a balanced field length (SR422A) of 3,400 ft. in I.S.A. at sea level. This requirement shows up in such features as the large-diameter propellers; the high-efficiency flaps, which are an interesting variation of the Fowler type; the closing of the undercarriage doors when the main legs are down; the powerful wheel brakes; and the large fin and rudder. The need to operate from airfields with poor surfaces dictated nosewheel steering; low-pressure tyres (40 p.s.i. nose and 59 p.s.i. main); a wide undercarriage track; and good ground clearance for the rear fuselage and the propellers.

Propeller clearance, in turn, controlled the location of the engines on top of the wing—although this was also desirable to avoid cutting into the torsion box. Despite the larger diameter, a clearance of 2 ft. has been obtained, compared with 15 in. for the inboard engines on the Viscount.

All the foregoing considerations controlled the size and shape of the Avro 748 within close limits—and explain, incidentally, its external similarity to certain other aircraft in the same category. The company is particularly emphatic in denying that the 748 owes anything to the Aviation Traders Accountant, for instance, which was designed for a similar job, but was structurally quite different.

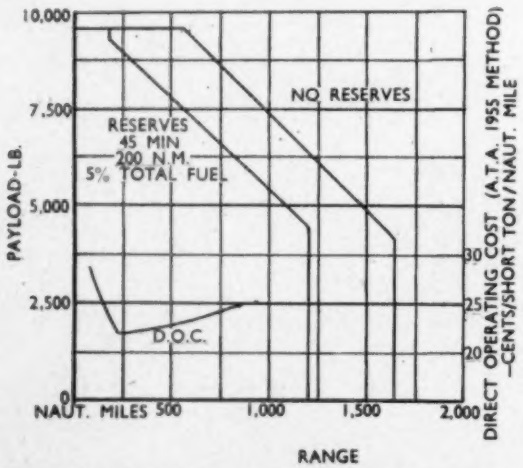
Structural Considerations

For the Avro 748 to be a success, it had to have not only the right kind of performance but also the right kind of costs. The Avro company already has a reputation for its low production costs, and this is likely to be useful in achieving the £170,000 price tag on the 748—furnished, but less radio. To keep the first costs down, the company has taken several interesting steps.

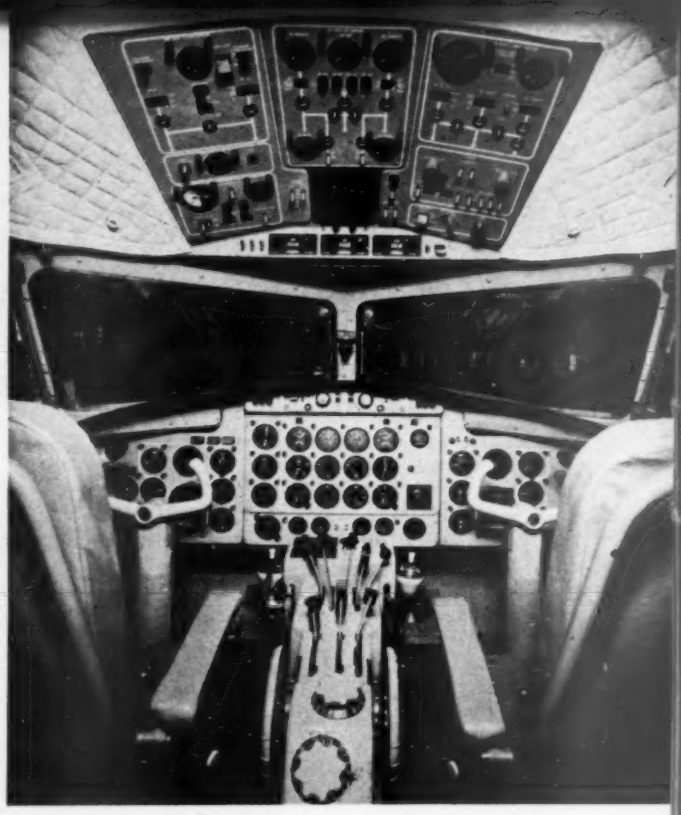
In the first place, the structure has been kept as simple and as light as possible and "sophisticated" solutions to structural problems have been avoided. The result is a structure which is largely made up of "bits of bent tin," with few large forgings or complicated assemblies. Then, in the choice of equipment, the designers have gone for items which are, wherever possible, already fully developed. The British Messier undercarriage is necessarily new, but the powerplant back to the firewall is Viscount 800, as is the Rotol gearbox; the propeller is F-27; the fuel, hydraulic and electric system components are almost entirely stock items; and the pressurization equipment, although new, is based on that for the Vanguard.

Avro invited component manufacturers to share in the development programme by providing components free for the prototypes and quoting a fixed price for production deliveries—on a competitive basis. The accessory makers have thus had to make their own estimates of the chances of the aircraft's success, and amortize any equipment development costs over the estimated production quantity.

The structural design of the Avro 748 follows fail-safe principles—making it one of the smallest aircraft yet designed



These payload-range curves are for the 40-seat arrangement. Cruise at 230 knots at 20,000 ft. is assumed, and the take-off weight of 33,000 lb. includes 320 lb. water-methanol allowance. The cost curve is based on the A.T.A. 1955 method, assuming 2,000 hr. annual utilization and five years' depreciation.



The cockpit in the specimen front fuselage is laid out for two-crew operation. The front cabin bulkhead is not structural and can be cut away to provide space for a radio operator and/or navigator.

to this concept. In order to provide a good fatigue life, zinc-bearing aluminium alloys have been avoided, and no magnesium is used in the structure. The fail-safe characteristics derive from a combination of duplicated load-path techniques, and the use of joints to limit the spread of cracks. For instance, the main wing spar webs are split into two, and the under-wing skin panels are in four spanwise sections.

Aluminium alloys such as L65, L72, L73 and L77 are used for their slow cracking rate, and maximum attention has been given to accessibility of the structure so that cracks can be quickly detected when they do occur. The whole structure, in fact, can be inspected visually through appropriate access holes—and without requiring undue gymnastic feats by the inspector. This accessibility is an important factor for an aeroplane which may spend a large part of its life operating in remote areas with the minimum of maintenance.

The structural simplicity already mentioned helps towards ease of inspection, and this was one of the principal reasons for rejecting metal bonding and spot-welding. Except for the top surface of the wing, all rivets are mushroom-headed, for reliability and to simplify repair schemes with the minimum of equipment.

The emphasis which has been placed on accessibility for inspection purposes leads naturally to simple servicing arrangements. With the exception of the overwing gravity refuelling point (if used) and the engine-oil and hydraulic fluid filling caps, no servicing points are more than 6 ft. above the ground, and 8-10 men can work on the airframe simultaneously. All major items of equipment are in bays under the cabin floor, where they can be reached through doors in the underside of the fuselage.

Major joints in the structure have been avoided, to keep down weight and cost and reduce the incidence of fatigue and maintenance effort. The key component in the 748 structure is the centre-section, which comprises the portion of the fuselage between the wing spars and incorporates the wing centre-section as an integral piece of structure. This centre-section goes into the main fuselage jig, and the front and rear fuselage are built on to it. Fuselage frames are simple channel sections, with the stringers running outside the frames and attached by finger plates.

Fuselage skin is 21g. The stress level due to pressurization is 9,000 p.s.i., which is inside the recommended limit to avoid crack propagation. The lower surface of the wing is continuous across the underside of the fuselage, giving an uninterrupted tension skin and keeping the spars below the cabin floor level.

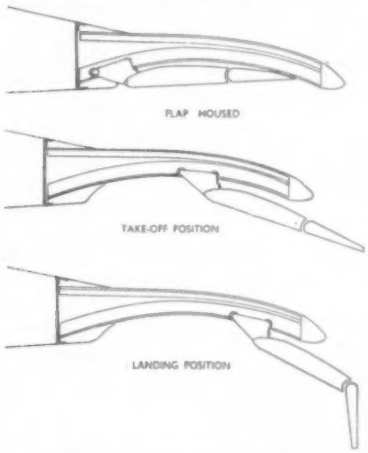
The two wing torsion boxes are each built in one piece from root to tip, the structure comprising web and boom spars, built-up ribs and Z-section stringers external to the ribs. The skin is 14g over the area of the fuel tanks and 18g outboard,

with the bottom, tension, skin in four spanwise panels, as already noted. One integral tank is provided in each wing, outboard of the engine position, with a capacity of 550 Imp. gallons.

All control surfaces are fully manual with a set-back hinge type of balance. The three-position, 30% chord flaps are in one piece on each wing, from aileron to root, and are basically of the Fowler type, moving round a conical path. The rear 35% of the flap chord is made up of a four-piece tab each side, which is designed to provide maximum drag without destroying lift in the landing configuration. For take-off, the flaps are at 22½° (75% of maximum travel), which is the optimum for lift with minimum drag. On the approach, a little more flap is used, and when the landing position is selected, the flaps move back to their full deflection of 30° and the tab then hinges down to an angle of about 50° to the flap. The elevator trim circuit incorporates automatic compensation for the nose-up pitch when the flap tab goes down.

Development Programme

As already noted, Avro are building four prototypes of the 748, of which the first should fly next February. The second is the static test specimen, the fuselage of which will undergo preliminary pressurization tests in an Armstrong Whitworth rig in December. The entire specimen will go into the Avro test rig at Woodford by the end of February, 1960. The third airframe is expected to fly in August, 1960, and the fourth, for fatigue testing, will go into a water tank at Avro's main Chadderton factory in June.



The three flap positions are shown here. The tab comes down automatically with full flap to increase drag without destroying lift.

A fatigue test cycle has been prepared for the water test, to represent take-off, climb and pressurization, gust loading, depressurization, flaps-down and landing. After this cycle has been repeated up to an equivalent of 60,000 flying hours, testing will continue to determine the rate of crack propagation in order to establish inspection periods, and, finally, fail-safe tests will be made by applying static loads on deliberate cracks. A small fuselage section with representative door and window cut-out details has already been tested in a water tank for 22,000 cycles at 5½ p.s.i.

Both flying prototypes will be test-instrumented, but will be otherwise representative of production aircraft, and the second will be furnished. A start has now been made on two more sets of jigs, for the production of an initial batch of 10 748s, the first to fly in November, 1960. Two production aircraft will join the prototypes in a 1,000-hr. test and certification programme, including tropical trials, which is due to be completed by March, 1961. It is likely that Skyways crews will participate in this programme at an early stage, and the company is already working closely with Avro.

The build-up of production beyond the first batch of 10 depends on the order situation, but up to 20 could be delivered during 1961. In a typical Hawker Siddeley Group arrangement, Armstrong Whitworth are designing the entire tail unit, while Gloster Aircraft are responsible for the ground equipment.

	Dart 514 (R.Da.6)	Dart 529 (R.Da.7)
Take-off distance to 35 ft. at max. take-off weight (33,000 lb.), I.S.A. S.L. conditions ..	2,520 ft.	2,160 ft.
Take-off balanced field length at max. take-off weight (33,000 lb.), I.S.A. S.L. conditions ..	3,500 ft.	2,880 ft.
Rate of climb at sea level (I.S.A.) at maximum recommended power at max. take-off weight	1,250 ft./min.	1,840 ft./min.
Service ceiling (100 ft./min) at max. recommended power (weight 33,000 lb.)	30,000 ft.	31,000 ft.
Cruising speed at maximum recommended power at mean weight of 31,000 lb.:		
at 20,000 ft.	230 knots	263 knots
at 25,000 ft.	228 knots	258 knots
Stage lengths with S.B.A.C. allowances:		
for maximum payload (9,666 lb.)	190 n.m.	170 n.m.
for 40 passengers with baggage	400 n.m.	390 n.m.
Payload for 1,000 n.m. stage length	5,355 lb.	5,350 lb.
Landing distance from 50 ft. at 33,000 lb. ..	2,310 ft.	2,310 ft.

It is not yet known how many 748s will be built in England for the Indian Air Force—which will, in any case, have a slightly heavier version with stronger floor and freight door. The Indian Minister of Defence recently explained that the agreement called for payment of a licence fee in eight annual instalments, beginning after the aircraft was certificated and approved by the Air Force. No royalty will be paid on the first 100 aircraft built in India (at Kanpur).

The measures taken by Avro to keep down the cost of the 748 have already been described. There is no doubt that the aircraft is the cheapest of its kind on the market and the low first cost naturally influences the operating costs. The direct costs not only compare favourably with those of competing new aircraft, but also with typical short-haul feeder-liners already in service, even when fully depreciated.

A study has already been made of the effect of fitting the more powerful Dart 529 (R.Da.7) engines. This can be done for a weight penalty of some 400 lb., including the higher weight of the engines and the stronger engine-support structure, and serves to improve the field performance and cruising speed without penalizing the direct operating costs.

To support the 748, the company has already set up a sales engineering department, and is also forming a new spares organization and a separate field service. Stocks of spares will be built up at regional points and, if sales develop on the American continent, Avro Aircraft in Canada may be made a source of spares as well as a supply point. For a company which has not been closely associated with the civil airline market for a number of years, the Avro approach to the design, production and sale of the 748 is impressive and should inspire the confidence of the quite considerable number of airlines which have shown real interest and for which detailed route analyses have already been prepared. The Avro 748 is the kind of aeroplane which should have a useful life of 15-20 years ahead of it and the reception which it has received so far is most promising.—F.G.S.

Dimensions
- Span: 95 ft. 0 in.
- Overall length: 67 ft. 0 in.
- Overall height: 24 ft. 10½ in.
- Gross wing area: 795 sq. ft.
- Sweepback: Nil.
- Internal cabin dimensions:
  - Length (ex. flight deck): 46 ft. 6 in.
  - Max. width: 97.2 in.
  - Max. height: 76.6 in.
  - Max. usable floor area (ex. flight deck): 296 sq. ft.
  - Max. usable volume (ex. flight deck): 1,990 cu. ft.

Accommodation
- Normal tourist: 36 (4 abreast)
- Max. coach: 44 (4 abreast)
- Volume of freight and baggage holds: Nil.

Powerplants
- Two Rolls-Royce Dart 514 (R.Da.6).
- Take-off power each (I.S.A., s.l.): 1,740 at 14,500 r.p.m.
- Rotol c.s., l.f. four-bladed propellers, 12 ft. diameter.

Weights and Loadings
- Basic operational: 19,444 lb.
- Total fuel: 8,910 lb.
- Mfrs. max. payload: 10,000 lb.
- Max. take-off: 33,000 lb.
- Max. landing: 33,000 lb.
- Max. zero fuel: 29,110 lb.
- Wing loading (max. t-o.wt.): 41.5 lb./sq. ft.
- Power loading (max. t-o.wt.): 9.5 lb./e.h.p.

Design Criteria
- Design limits: V_C=225 k. E.A.S. Vne=270 k. E.A.S. Vd=300 k. E.A.S.

Performance
- Cont. cruising speed (I.S.A.): 230 knots (at 20,000 ft. and 31,000 lb.); consumption: 0.675 lb./s.h.p./hr.
- Approach speed (at max. landing wt.): 91.9 knots.
- Landing distance from 50 ft. (unfactored, max. landing wt.): 2,310 ft.
- Balanced field lengths (at max. t-o.wt.):—
  - At I.S.A. at sea level: 3,500 ft.
  - At I.S.A. +15°C at sea level: 3,750 ft.
  - At I.S.A. at 5,000 ft.: 4,750 ft.
- Range (take-off to landing), still air no reserves, I.S.A., max. fuel (1,100 Imp. gal.): 1,630 naut. mi. with 4,420 lb. payload at 230 knots (mean) at 20,000 ft. (mean).
- Range (take-off to landing) still air, no reserves, I.S.A., with max. payload: 580 naut. mi.

Structure: Two-spar wing in one piece each side, attaching to integral wing/fuselage centre section. Integral fuel tanks outboard of engines. Circular section fuselage. Principal materials, L.65, L.72, L.73 and L.77 aluminium alloys.

Undercarriage: Twin-wheel main units retracting forwards into nacelles. Twin-wheel steerable nose-wheel retracting forwards into fuselage. Hydraulic brakes.

Flaps: Fowler type in one piece each side, with additional trailing edge tab to increase drag in landing configuration. Electrically operated.

Flying Controls: All manual, with set-back hinges, and horn-balanced rudder. Gear tab on each aileron and trim tab on one. Gear trim tabs on both elevators. Separate spring and trim tabs on rudder.

Systems: 2,500 p.s.i. hydraulic system powered by two engine-driven pumps for u/c, brakes, nose-wheel steering and optional propeller brakes (plus manual emergency pump for u/c). Primary 28 v. DC electric system from two engine-driven generators, plus two alternators for 115 v. AC and a third alternator for 200 v. AC for engine and propeller de-icing. Cabin pressurization at 4.2 p.s.i. by engine-driven blowers. De-icing of wing and tail unit by chordwise rubber boots energized by compressor bled air.

Mach-2.5 Strik

The Ha

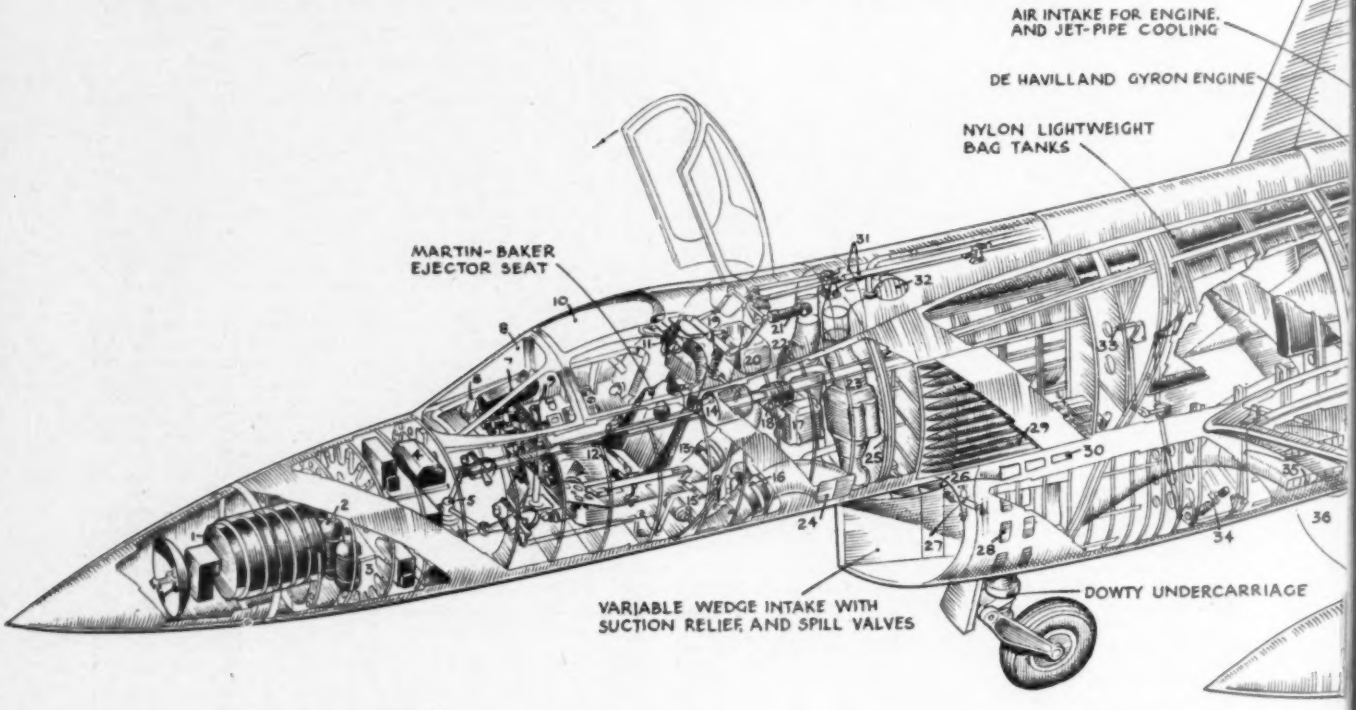
IF the Royal Air Force had decided to adopt the Hawker P.1121, this dual-rôle Mach-2.5 interceptor and strike aircraft might well have been in service by 1960 or 1961. Designed by Hawker Aircraft as a private venture, a prototype of this potent aircraft was nearly completed but its development was ended when it became clear that no production orders were likely to be received.

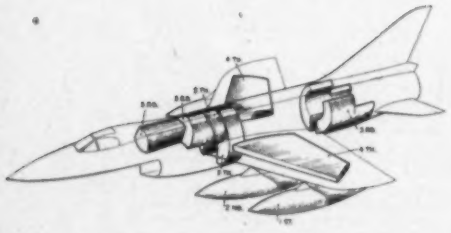
Britain will not have a supersonic strike aircraft whose performance compares with the P.1121's until 1964 when the TSR-2 "Canberra replacement" is due to enter service; this is rather unfortunate, as several other countries have Mach-2 strike aircraft either in service or close to it. These include the U.S. Republic F-105 Thunderchief, the French Mirage 3 and the Swedish Saab Draken. Until the TSR-2 comes into service the R.A.F. will rely on Canberras and Hunters for the tactical strike rôle, with Valiants being used by night.

The history of the P.1121 goes back to March, 1954, when the Air Staff issued Operational Requirement 329 for an advanced Mach-2 fighter armed with guided weapons for the defence of the British Isles. The Hawker P.1103 was evolved in April, 1954, to this requirement. It was an all-swept mid-wing two-seat fighter of 35,000 lb. all-up weight powered by a de Havilland Gyron with reheat.

The design of this aircraft was developed during 1954 and, after receipt of the official specification early in 1955, a formal tender was submitted to the Ministry of Supply in October, 1955. By this time a great deal of design work on the structure had been completed and wind-tunnel models were under way.

At about this time the development of surface-to-air missiles was leading to doubts about the future value of specialist interceptors and, in fact, of the manned military aircraft itself. These views culminated in an uncompromising form in the famous 1957 White Paper on Defence. As a result of the growth of


AIR INTAKE FOR ENGINE AND JET-PIPE COOLING
DE HAVILLAND GYRON ENGINE
NYLON LIGHTWEIGHT BAG TANKS
MARTIN-BAKER EJECTOR SEAT
VARIABLE WEDGE INTAKE WITH SUCTION RELIEF AND SPILL VALVES
DOWTY UNDERCARRIAGE



Fuel tank layout showing order used.

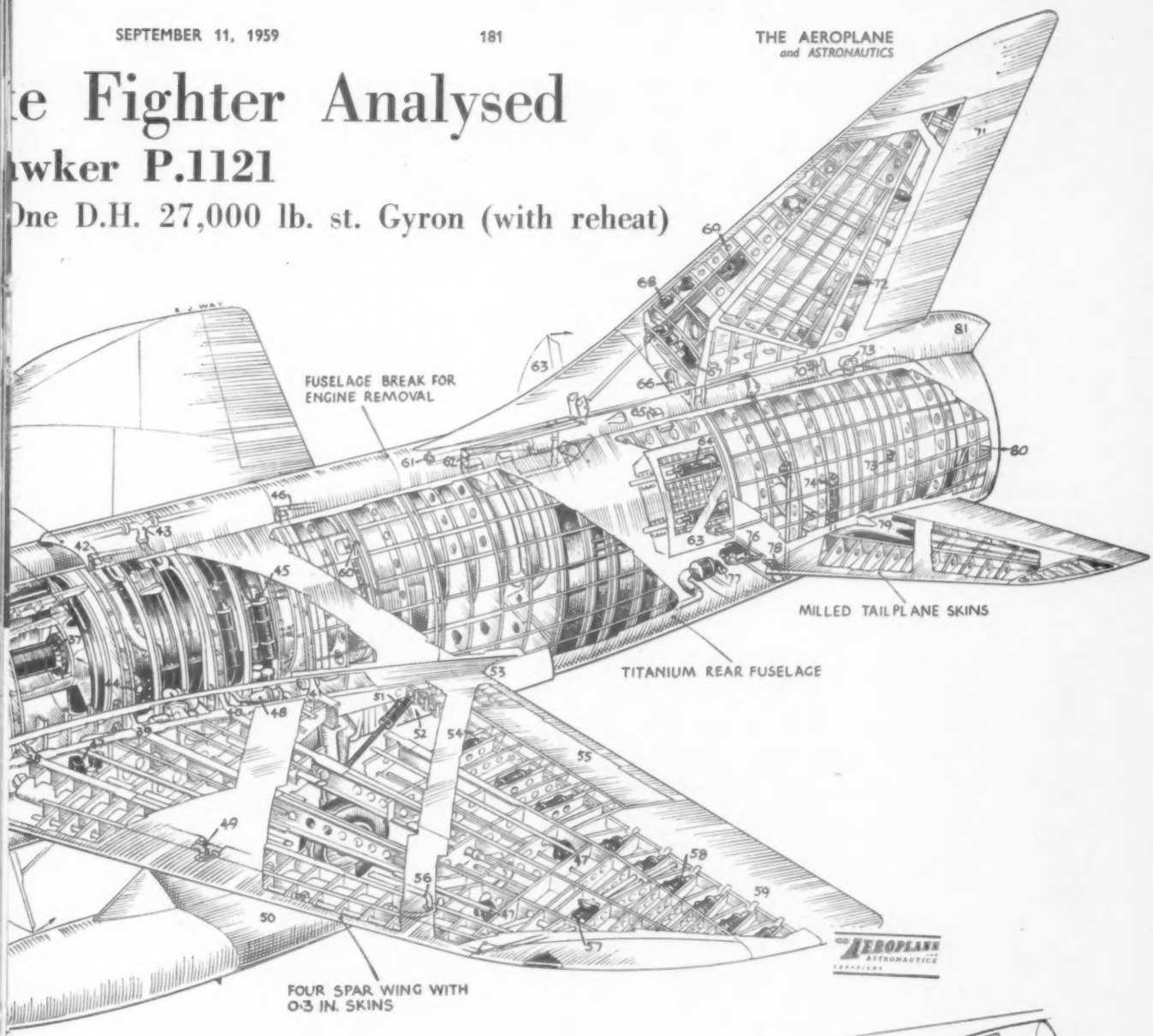
Key

1. Radar equipment.
2. Oxygen bottles.
3. Front pressure bulkhead.
4. Radio equipment.
5. Rudder pedals.
6. Windscreen warm-air pipe.
7. Weapon sight.
8. Three-piece toughened-glass windscreen.
9. Control column.
10. Three-piece toughened glass hinged hood.
11. Hood jettison spring box.
12. Throttle slide.
13. Ram-air turbine (emergency electrics).
14. Water extractor.
15. Ram-air turbine intake operating jack.
16. Ram air-turbine (emergency hydraulics).
17. Evaporator.
18. Cold-air unit.
19. Hood-lock release jack.
20. Air-conditioning water tank.
21. Hood-raising jack.
22. Pre-cooler.
23. Inter-cooler.
24. Emergency ram-air turbine outlet.
25. Front-to-centre fuselage joint.
26. Boundary-layer bleed.
27. Variable-wedge intake operating jacks.
28. Suction-relief doors.
29. Retractable rocket pack.
30. Boundary-layer bleed outlets.
31. Rudder and elevator control rods along dorsal spine.
32. Inter-cooler outlet.
33. Aileron-control push rod.
34. Aileron-control feel unit
35. Air-intake spill ducts.
36. Ventral air brake.
37. Engine electric starter motor.
38. First wing-fuselage joint.
39. Second wing-fuselage joint.
40. Third wing-fuselage joint.
41. Fourth wing-fuselage joint.
42. Zone 1 engine-bay cooling-air intake.
43. Fuselage fuel-tank vent pipe along dorsal spine.
44. Front engine mounting.
45. Fuel accumulators.
46. Zone 2 engine-bay cooling-air intake.
47. Wing fuel transfer valve.
48. Wing tank refuelling valve.
49. Low pressure venting, and fuel delivery pipes for inner drop-tank pylon.
50. Wing drop tank (four can be carried).
51. Main undercarriage operating jack.
52. Refuelling connection in main undercarriage bay.
53. Rear upper main undercarriage door.
54. Three hydraulic flap jacks (air blown for emergency operation).
55. Flap.
56. Low pressure venting, and fuel delivery pipes for outer drop-tank pylon.
57. Aileron hydraulic control unit.
58. Six hydraulic aileron jacks (three for each system).
59. Aileron.
60. Engine rear mounting.
61. Control rods and vent pipes in dorsal spine.
62. Zone 3 engine bay, and jet pipe cooling-air intakes.
63. Rear air brakes.
64. Air brake operating jacks.
65. Auxiliary air intake for rear fuselage cooling.
66. Fuselage-to-fin front-spar joint.
67. Rudder valve unit.
68. Rudder trim and feel unit.
69. Rudder control unit.
70. Fuselage-to-fin rear-spar joint.
71. Rudder.
72. Two rudder hydraulic jacks (one for each system).
73. Jet pipe mounting.
74. Tailplane operating jacks (port and starboard).
75. Tailplane coupling tube.
76. Tailplane hydraulic control unit.
77. Reheat pump.
78. Tailplane control feel unit.
79. Tailplane-coupling tube bolted to forged steel billet.
80. Rear fuselage cooling-air outlet.
81. Tail parachute stowage.

te Fighter Analysed

awker P.1121

One D.H. 27,000 lb. st. Gyron (with reheat)



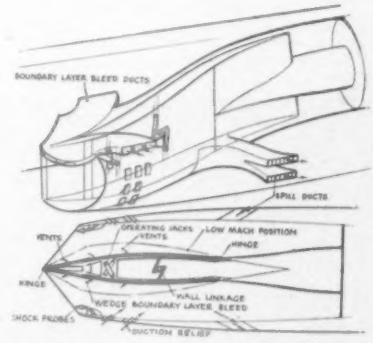
this philosophy, official support for the P.1103 came to an end in mid-1956 and the aircraft of this specification never materialized.

However, at this time the first whispers of the "Canberra replacement" O.R. were prevalent. Hawkers decided to redesign the P.1103 to meet the anticipated Service requirements and in May, 1956, the basic configuration of the P.1121 was settled. It retained the centre fuselage, engine installation, main undercarriage and much of the basic wing of the P.1103, but featured a new single-seat front fuselage and a new tail unit.

The P.1121 was envisaged as an air superiority and strike aircraft with applications to both high-altitude defence and to low-altitude strike duties. The aircraft was expected to complement the fully automatic missile systems of air defence being introduced by developed countries, and was intended to play a major rôle in limited wars where fully automatic weapon systems were neither practical nor justified. The design philosophy was to achieve the maximum performance and operational flexibility using conventional design and construction techniques within a time scale which envisaged the aircraft entering service in 1960-61.

Hawkers were confident that the R.A.F. would need such an aircraft and, although developed entirely as a private venture, the Service showed a definite interest in it.

During 1957 O.R.339, the requirement to which the TSR-2 will be built, became available. This called for a larger radius of action than the P.1121 and more sophisticated navigational equipment which necessitated a second crew member. As a result



Variable-wedge intake.

of this, design emphasis on the P.1121 was inclined more to the ground attack and tactical strike rôle and a two-seat version was evolved carrying more equipment and having greater range.

This came closer to O.R.339 requirements but retained much of the P.1121's original dual-purpose rôle. It was felt at the time in some quarters that the full O.R.339 aircraft would be too expensive for this country to build and operate in view of its specialist rôle, and Hawkers were encouraged to continue in these P.1121 developments.

Despite this Service interest no orders for the P.1121 were forthcoming, and in September, 1957, the Hawker Siddeley Group decided that work on the aircraft could be continued only

at a much reduced rate compared with that employed hitherto. At this time the first prototype P.1121 was almost complete structurally except for the rear fuselage and tail unit.

During 1958 work on this airframe was continued at very low priority until last December when it was decided to end the project completely. Up to this time more than £1 million had been spent on the project by Hawkers and at least an equal amount had been spent by the various ancillary equipment companies who had pledged their support to this private-venture aircraft.

P.1121 in Detail

Features of the design were a single engine, a swept wing with full ground-attack strength factors, a large internal fuel capacity and provision for a wide range of weapons to be carried externally on underwing pylons.

Hawkers studied a range of powerplants for the P.1121 including the de Havilland Gyron, the Bristol Olympus and the Rolls-Royce Conway, all with reheat. The prototype was to have had a Gyron engine; this gave the best performance for supersonic interception at high altitude, but was not ideal for the strike rôle. The Conway was the best engine for the low-level strike version because of its low fuel consumption, while the Olympus was the best compromise for a combined strike and interception aircraft.

The prototype P.1121 carried only the pilot and its operational equipment was to include a LABS system and Doppler navigator for the delivery of high-explosive and nuclear bombs in the low-level strike rôle, combined with AI search radar and 30-mm. cannon, unguided rockets and Firestreak AAMs when used as an interceptor. Interchangeable armament and equipment packs would allow the aircraft to operate in either rôle.

The two-seat strike version would have had ground-mapping radar as well as Doppler to ensure accurate navigation. Sideways-viewing radar was to have been mounted in underwing pods and forward-looking radar, developed from existing AI radar, would have helped the pilot to avoid defended areas and, on the approach to a target, to detect the landmarks on which a LABS attack would be based. This equipment allowed the aircraft to be used for all-weather reconnaissance, with cameras installed in addition to the mapping-radar equipment.

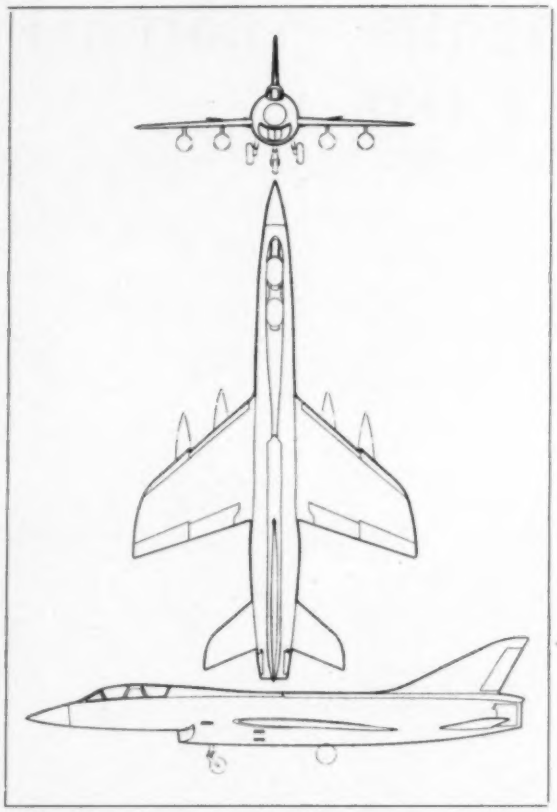
A further development of this P.1121 version was studied in which the undercarriage would have retracted into wing nacelles, allowing a centrally mounted fuel or bomb nacelle to be carried. This would have increased the total fuel capacity to 3,000 gal. This pod could also have been used to carry electronic counter-measure equipment.

Another version of the P.1121 was examined in detail; it had a more powerful engine and an all-steel wing. This aircraft could have operated as a high-altitude interceptor at speeds up to and above Mach 3.

Design Features.

Design requirements for a high-altitude interceptor and a low-level strike aircraft may appear incompatible on first sight. In fact, Hawker studies show that no significant penalties were involved in designing the aircraft for the dual rôle.

The structure needed to withstand 7g loads for manœuvring at altitude at Mach 2.5; if designed to take 7g at the high temperature of Mach-2.5 flight, it would perforce be strong enough to withstand at least 8g for ground attacks at transonic speeds.



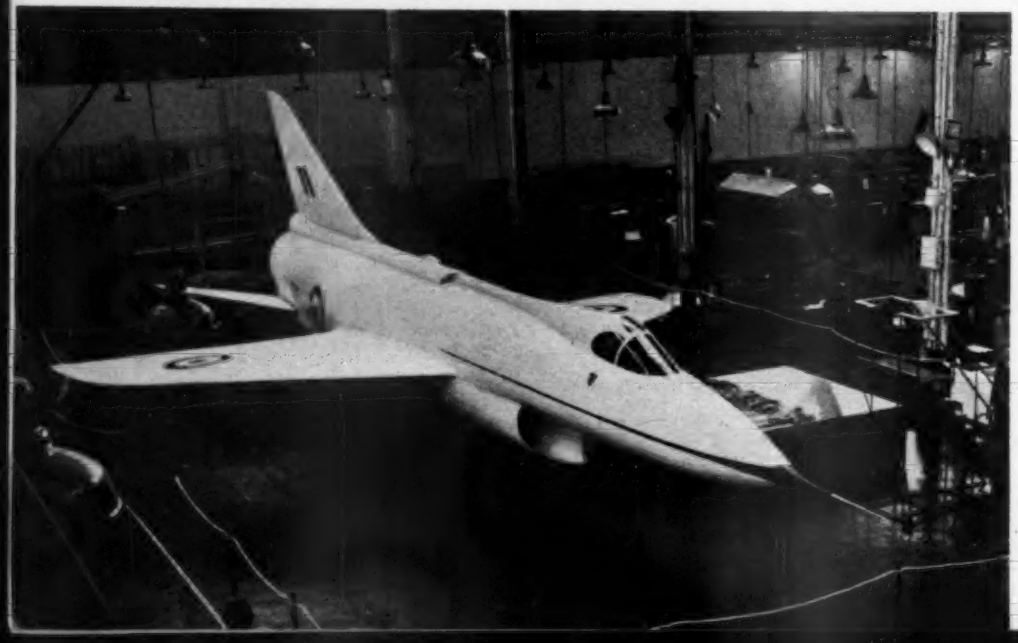
STRIKE VERSION.—This two-seat development of the P.1121 was designed primarily as a supersonic strike and reconnaissance aircraft. It was Olympus-engined and had increased tankage.

In addition, in climbs to interception altitude it was desirable for the aircraft to reach Mach 2.5 at about 36,000 ft. using the optimum energy height climb technique which implied a design speed of about 800 kt. E.A.S.

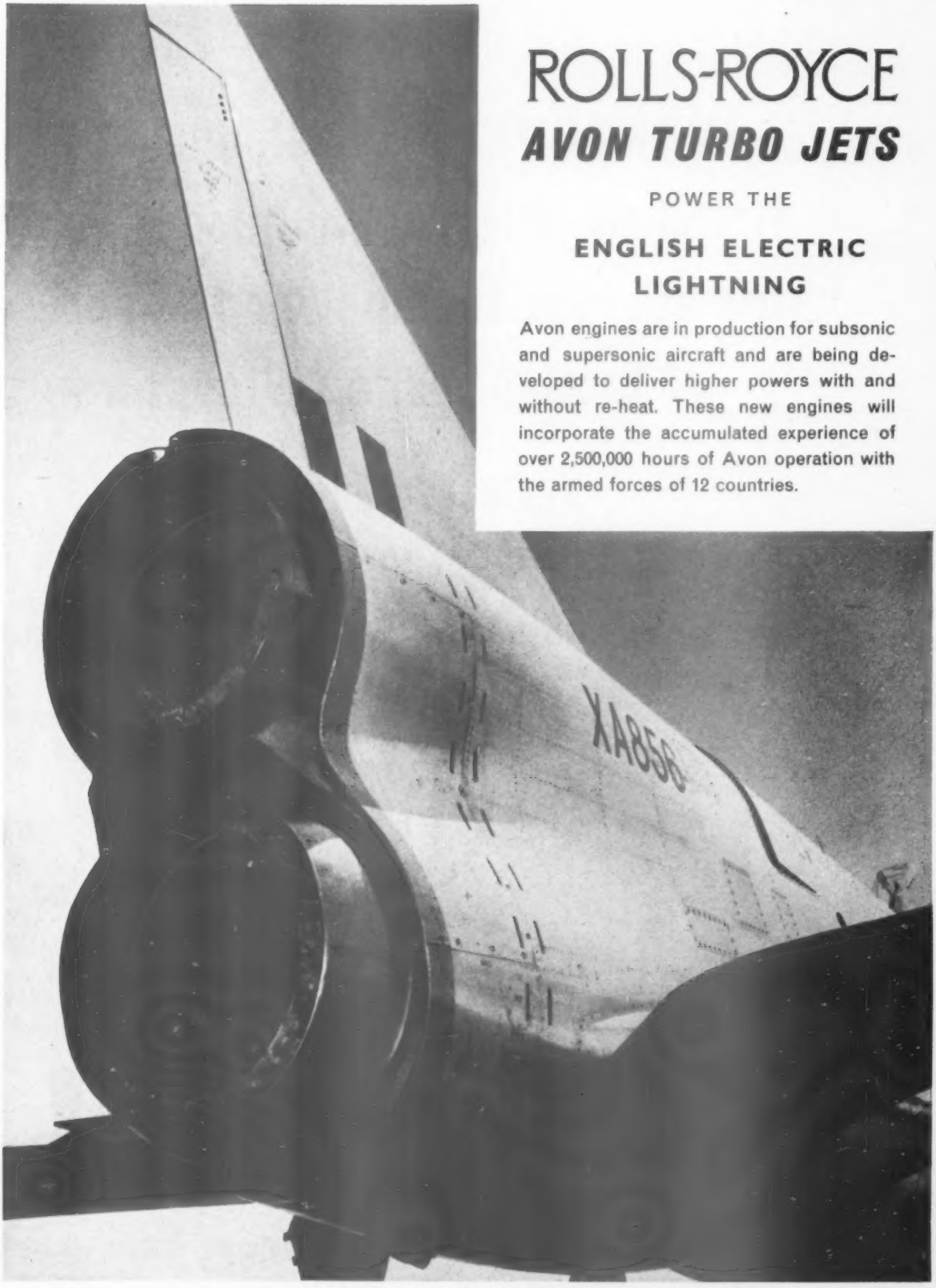
Thus, designing a structure for Mach 2.5 at high altitude is compatible with transonic operation at low level. The airframe of the P.1121 was designed for ground attack at speeds up to 850 kt. E.A.S. and Mach 1.3 at sea level and speeds up to Mach 2.5 for the high-altitude air superiority rôle.

Its airframe was protected against fatigue by the Hawker practice of designing with high reserve factors over the nominal design normal accelerations. This makes for rapid

(*Continued on page 183*)



MOCK-UP.—This full-scale mock-up of the P.1121 was built at the Hawker Kingston works.



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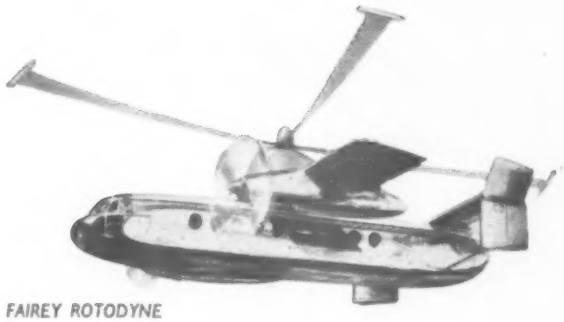
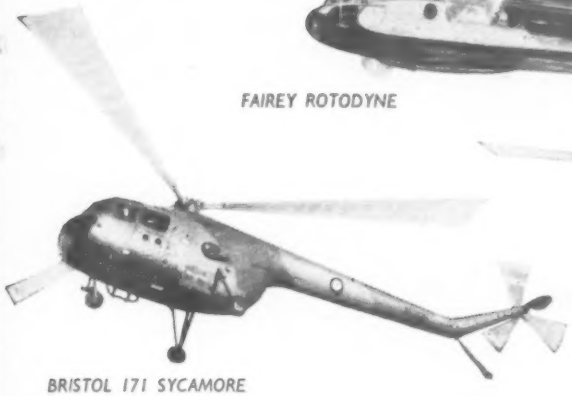


FAIREY ROTODYNE



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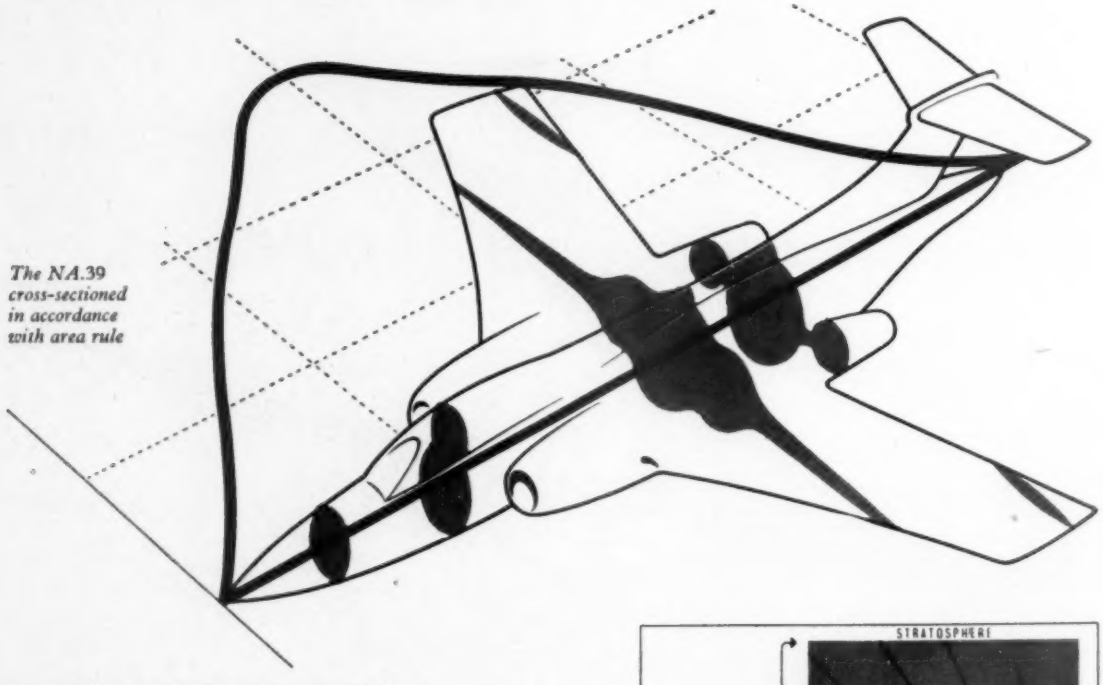
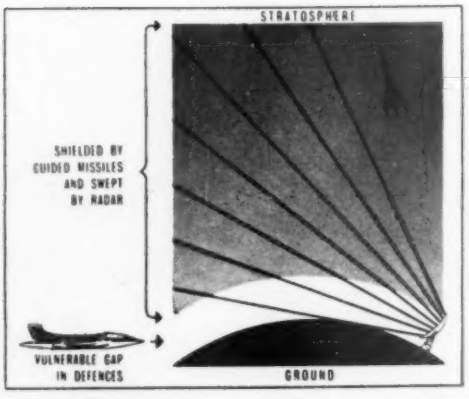


The NA.39 cross-sectioned in accordance with area rule

Area rule minimises drag because it allows the airflow *gradually* to contract and expand over the *total* cross-section of the aircraft. This has special virtues for high-speed, low-level flying because it ensures good control response and a smoother ride for the crew.



* *"In the low-level strike role, the NA.39 is ahead of any other aircraft in the world."*
Ministry of Defence.

Blackburn

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A139/a

(*Continued from page 182*)

and easy development to increased all-up weights during the life of an aircraft.

Hunter experience has shown that generous reserve factors can be achieved at only a small cost in weight; this is amply repaid by reliability and long life of the structure in operational service. The Hunter, for example, has an ultimate strength of 14*g* at combat weight.

The P.1121 was constructed mainly of light alloy, with high-tensile steel and titanium where local stressing conditions justified their use. Hawkers considered that this approach gave the most economical structure for an aircraft which would be used both for ground attack and for short-period penetration to high Mach numbers in the stratosphere.

In general, the airframe was built on conventional lines with closely spaced frames, or ribs, and stringers supporting heavy-gauge light-alloy skins. Steel was used for highly stressed parts and in places where there were large local loads.

The wing had four main spars with heavy steel booms. Pin-joint fittings attached the spars to the four heavy frames around which the centre fuselage was built. There was provision for two external weapon or drop-tank pylons on each wing. The ailerons and flaps had light-alloy skins bonded to a light-alloy honeycomb core.

The fin was a two-spar structure with light-alloy skin and ribs, and the rudder had the same metal-honeycomb construction as the ailerons. The slab tailplane had upper and lower surfaces machined from light-alloy billets. The port and starboard halves of the tailplane were connected across the fuselage by a 7-in.-diameter steel tube which was joined to the machined skins on each side of the fuselage by large forged-steel fittings.

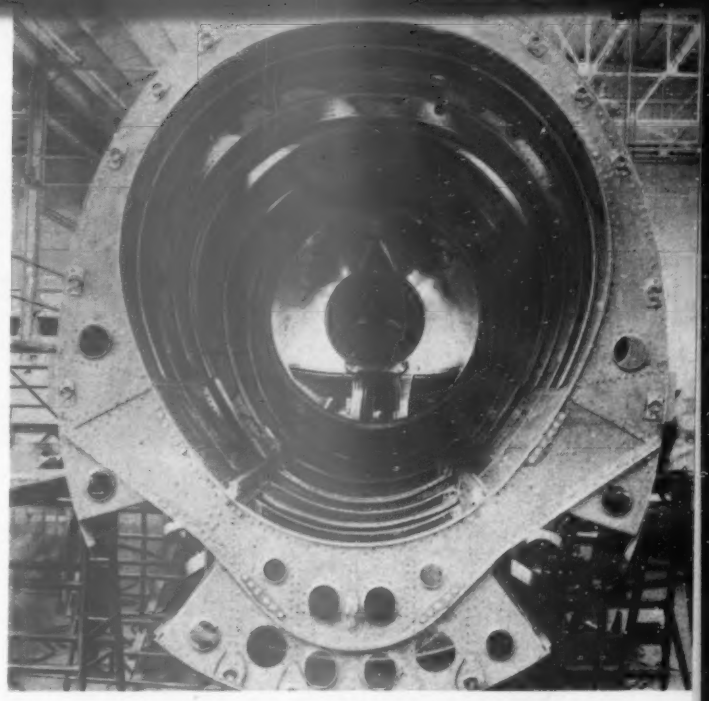
Aerodynamic Features

A thin moderately swept wing of low aspect ratio was chosen for the P.1121. It had a 36° sweep on the ¼ chord line and tapered in thickness from 5.1% at the root to 3.8% at the tip. A sawtooth leading-edge was to be fitted on production aircraft to eliminate slight pitch-up, but was not proposed for initial prototype flying. It was also intended to install high-lift devices such as a drooped leading-edge or blown flaps following test-flying experience with the prototypes.

Conventional ailerons were chosen rather than inboard ones, as they allowed normal flaps to be fitted and the wing structure was stiff enough to prevent aileron reversal. The wing had 2° of anhedral to offset the dihedral effect of its sweep.

The fuselage was Area-ruled for Mach 1.4; the most noticeable effect of this was a bulge in the rear fuselage. Weapons were to be carried externally, as studies showed that this was more economical than having a larger-diameter fuselage with an internal weapon bay.

The all-moving dihedral tail was set as low as ground clearance allowed. The rear airbrake position, on the fuselage side ahead of the tail unit, was chosen so that the airbrakes would have little effect on the flow over the tail. The airbrake under the fuselage was just behind the wing leading-edge.



PROTOTYPE CONSTRUCTION.—The fuselage of the P.1121 fitted closely around its Gyron engine. This is the view looking forward up the centre fuselage of the first prototype.

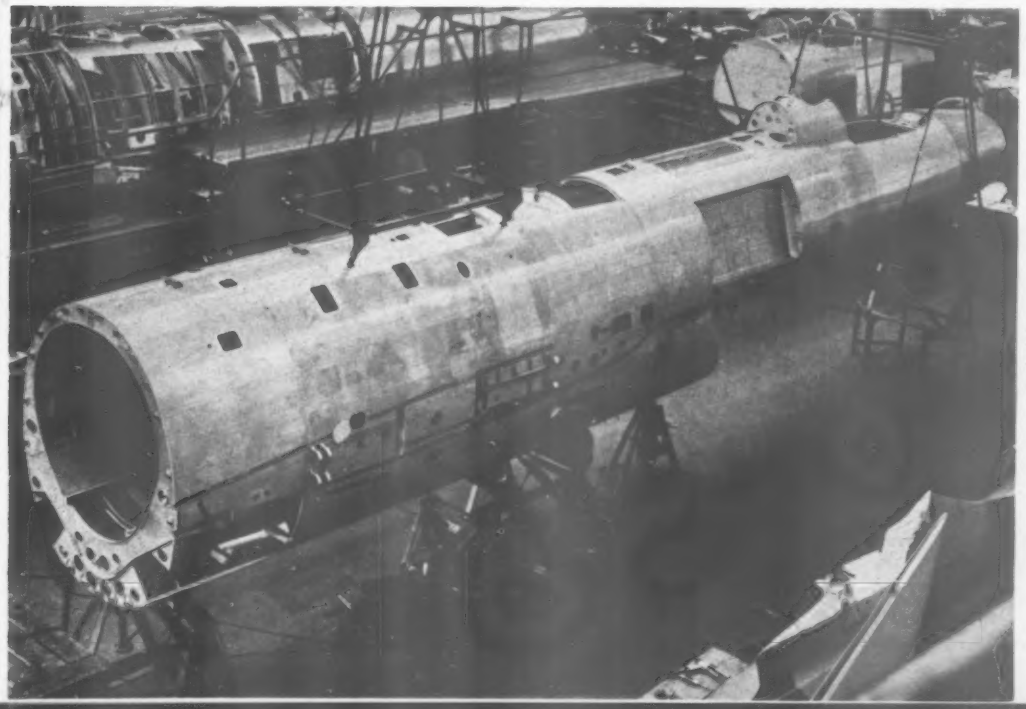
Inertia coupling in rolling manœuvres was studied and, despite the large fin area, it was thought that continuous rolling with full aileron might have had to be restricted. If flight tests had shown the need for greater weathercock stability, it was proposed to fit an underfin which would fold to give adequate ground clearance during take-off and landing.

Intake

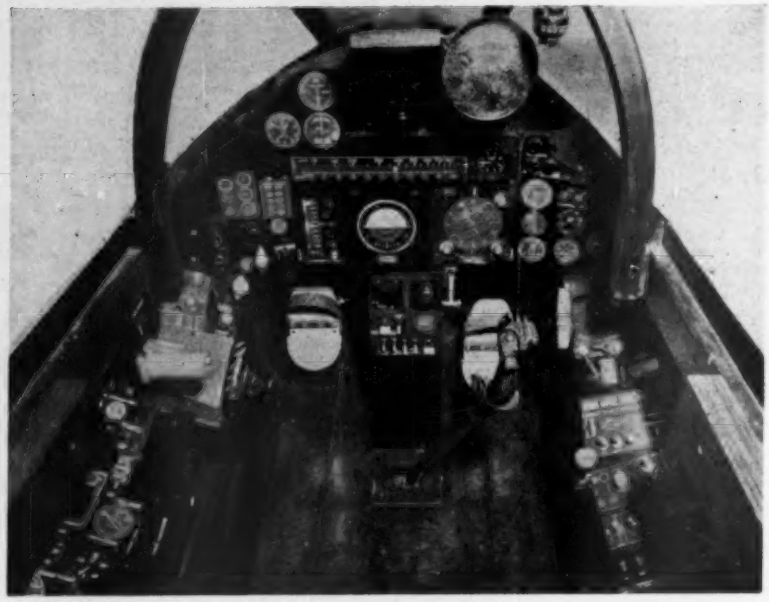
A two-dimensional ramp-compression intake was chosen for the P.1121 as it was considered that this would prove highly efficient and stable for supersonic flight. Flow into this underslung intake was to be divided by a vertical wedge whose apex angle was to be varied by an automatic control system.

Shockwave-position sensors were to be used to control the wedge angle and the opening of spillage valves. The position of the oblique shockwave was to be sensed so that the variable-angle intake wedge maintained this shock just ahead of the intake lips—this is necessary for high pressure recovery and low spillage drag. A second system was to sense the position of the normal shockwave and regulate the amount of after-spillage to avoid shock patterns at the intake entry which are known to produce intake buzz.

To eliminate shock-induced separation on the centre wedge,



FUSELAGE STRUCTURE.—The basic structure of the front and centre fuselage for the first P.1121 prototype was completed in late 1957.



IN THE OFFICE.—The latest flight-instrument presentation was to have been installed in the P.1121, as this mock-up photograph shows. Note the radar scope on the right above the instrument panel.

TUNNEL MODEL.—Low-speed wind-tunnel tests were made with this ¼-scale model of the P.1121.

boundary-layer bleeds were to be provided on each face of the wedge just behind the entry to the intake. Large suction-relief doors were built into the intake sides to reduce the adverse effect of the sharp intake lips during take-off and at low flight speeds.

Systems and Services

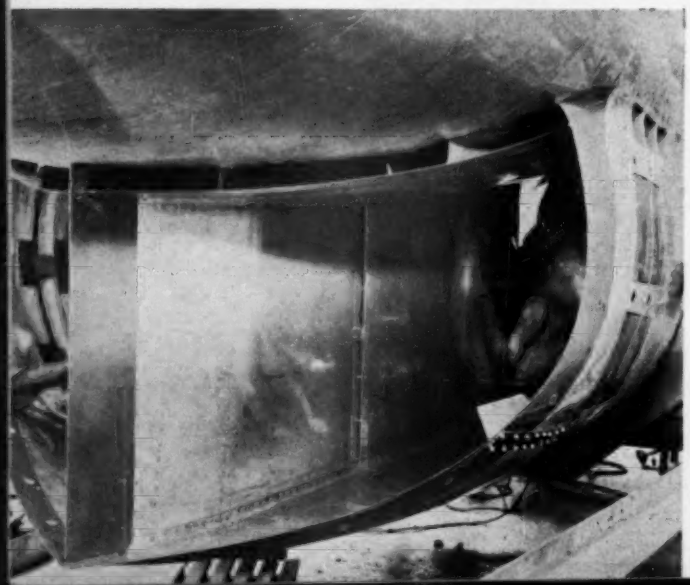
Internal fuel capacity of the P.1121 was 1,500 gal. and up to 600 gal. in addition could be carried in underwing drop tanks. A diagram on page 180 shows the position of the P.1121's fuel tanks.

Duplicated power controls were installed; hydraulic power was supplied by two independent systems with a ram-air turbine as an emergency power source. Autopilot and auto-stabiliser were integrated with the main control system and the autopilot could be interconnected with the airborne-interception radar, ILS or navigation system, thus making the P.1121 a fully-automatic weapon system.

The aircraft had three independent 4,000-p.s.i. hydraulic systems. The general-services system supplied power for undercarriage, flap and airbrake operation and the other two systems supplied power only to the flying-control jacks.

The electrical system was basically AC, with power provided by two engine-driven 20 kVA alternators working at 200-volt, 3-phase, 400 c/s. The main AC system gave power for the flying-control feel and trim systems, radar and weapons, radio and navigation, air-intake controls and other smaller systems. Emergency power was given by a small ram-air turbo-alternator.

As indicated earlier, the initial performance of the P.1121 would have been impressive and design studies had been made for a range of more advanced variants before the aircraft's development was cancelled. The aircraft clearly had a considerable stretch potential, and might well have rivalled the Spitfire and Hunter in the range and versatility of its variants. But, despite Hawker Aircraft's enterprise and faith in the aircraft, this was not to be. Many more than those at Kingston must feel that it was a pity, if not a mistake, that this advanced aircraft received no official backing.—J.R.C.



INTAKE RIG.—This full-scale intake was connected to Gyron and Olympus engines for static engine running tests. The intake throat and wedge boundary-layer bleeds can be seen.

Technical Data
Gyron-engined P.1121

DIMENSIONS.—Span, 37 ft.; overall length, 66 ft. 6 in.; overall height, 15 ft. 4 in. (standing attitude); wing area, 474 sq. ft.

WEIGHTS.—Structure, 14,905 lb.; normal all-up, 43,255 lb.; overload all-up, 48,150 lb.

PERFORMANCE.—Maximum speed at 50,000 ft., Mach 2.5 (design limit); ceiling at thrust limit, 64,000 ft.; combat radius for interception at Mach 2.5, 230 n.m.; combat radius for high/low-level strike sorties, 440 n.m.; ferry ranges, 1,740 n.m.

Developed Two-seat Strike Version (Olympus-engined)

DIMENSIONS.—Span, 39 ft.; overall length, 70 ft.; overall height, 15 ft. 4 in.; wing area, 509 sq. ft.

WEIGHTS.—Structure, 16,240 lb.; normal all-up, 50,010 lb.; overload all-up, 53,890 lb.

PERFORMANCE.—Combat radius for high/low-level strike sorties, 780 n.m.; time for high-level attack on target 300 n.m. away, 20 min.

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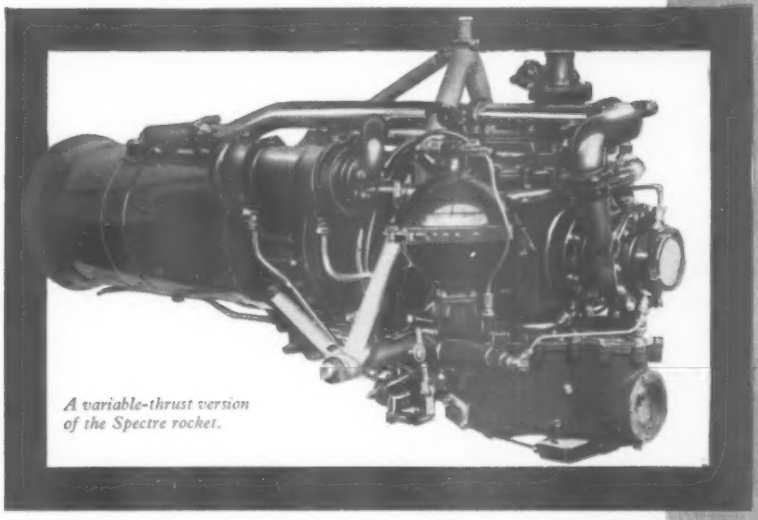
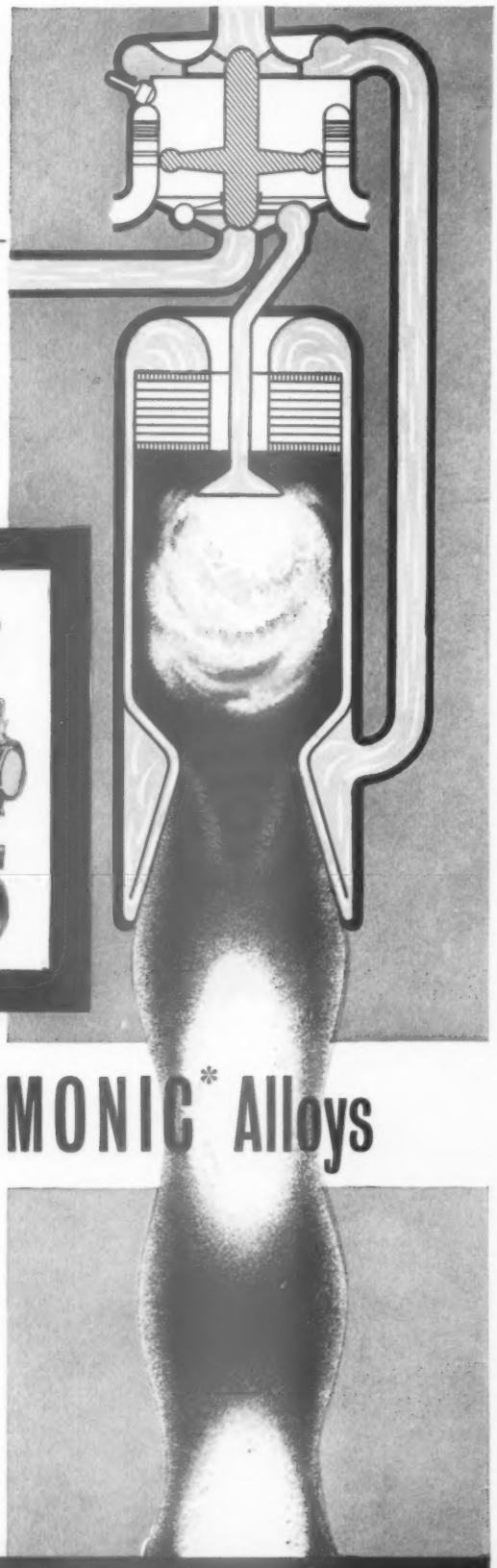


A variable-thrust version of the Spectre rocket.



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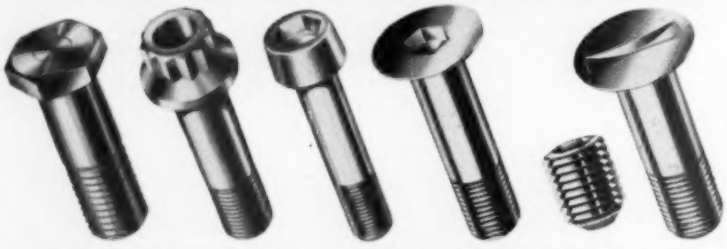

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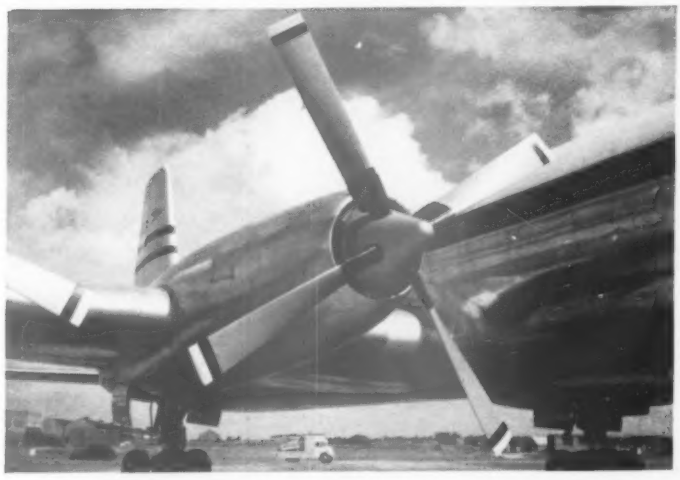

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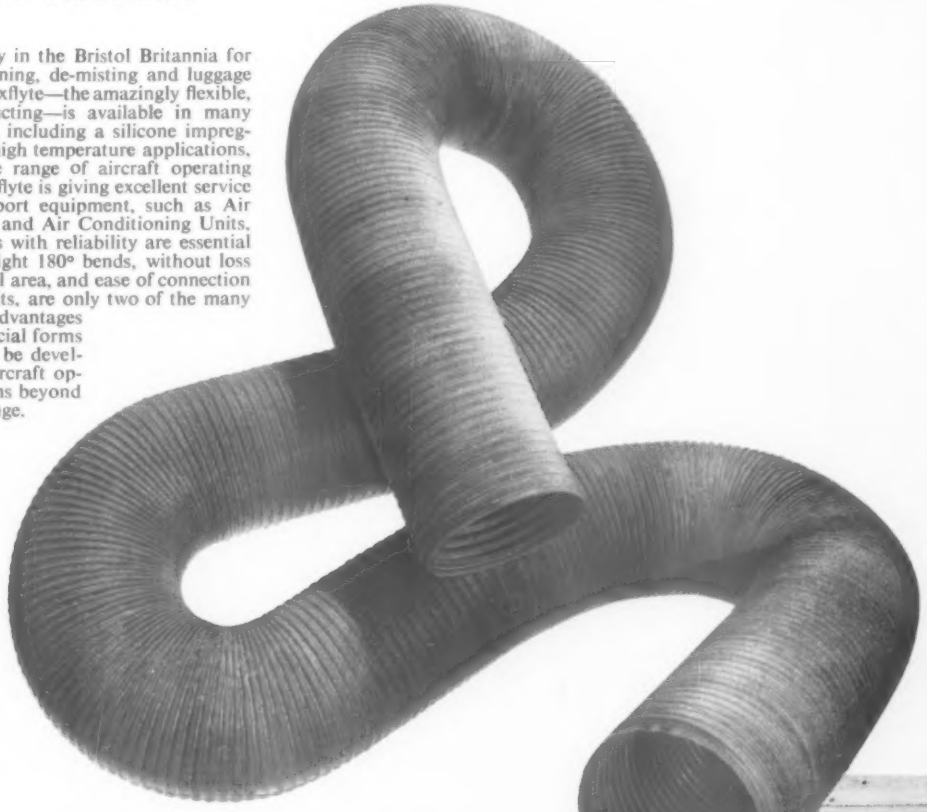

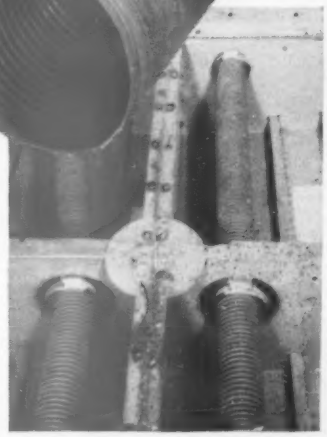

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SEASLUG CONTROL SYSTEM

Farnborough exhibits include components of the Seaslug SAM's control system, which is described here in detail.

SEASLUG is a ship-to-air missile for ships of the Royal Navy to fire either singly or in salvo as an anti-aircraft weapon. A radar beam directed at the target from the ship provides an invisible course for the weapon to follow and the missile, which virtually flies along this beam, is a "beam rider." The main contractors for this missile are Sir W. G. Armstrong Whitworth Aircraft Ltd., The General Electric Co., Ltd. (guidance), and Sperry Gyroscope Co., Ltd. (control system).

Structurally, Seaslug is a cylindrical missile with tapered nose, and has four fixed wings near the centre-section. Four aerodynamic control surfaces at the tail normally lie in the planes of the wings, but may be deflected for control and steering purposes. These surfaces direct the missile along the beam to its objective.

At launch, the rapid acceleration required is provided by four solid-fuel boost motors. These are attached to the body of the missile and fall off when spent. The missile continues under the power of a solid sustainer motor in its centre body, and is guided along the beam to the attacking aircraft.

Guidance signals for the control system are derived by a radar receiver in the missile which interprets the signals obtained by a radar aerial. An electro-hydraulic control system transforms these signals into movements of the control surfaces and initiates the corrective action needed to maintain the required course.

Flight Phases

To follow the operation of the control system it is essential to know the cycle of events in a Seaslug flight. This is divided into five phases—the boost phase; the roll-stabilization phase; the gathering phase; the guidance phase; and the interception phase.

In the boost phase the missile is accelerated to the required flight velocity by its four boost motors. These lie close to the weapon's body between the wings, with their outlet nozzles angled outwards and sidewards. The outward angle ensures that the boost efflux clears the control surfaces and the sideward angle imparts a spin or roll to the missile. This ensures that any variation in the thrusts of the four boosts is distributed about the line of flight, thus reducing any dispersion tendency during the boost phase.

Seaslug launch from H.M.S. Girdle Ness.

Mechanical attachments hold the boosts in place; they are designed so that as the thrust decreases the boosts slide rearwards and are released. They then "flower" outwards nose first and fall into the sea. For the remainder of its powered flight the missile velocity is maintained by the sustainer motor.

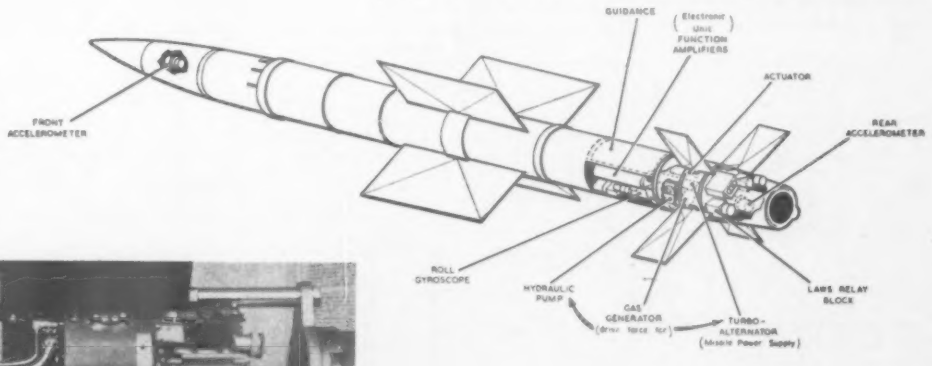
After the boost phase the Seaslug is airborne, with the required velocity and with an approximate heading. But it is rolling and probably dispersed from the guiding beam. Before directional control can be applied the rolling motion must be stopped and the missile orientated correctly with respect to the beam so that control can be applied in the correct sense (i.e., up/down, left/right). This is the purpose of the roll-stabilization phase.

To halt the rolling motion all four control surfaces are deflected and the missile is finally stabilized with one pair of fins vertical. A stable reference with which Seaslug is aligned is provided by a free gyroscope in the control system which is known as the roll gyroscope. This roll control persists throughout the flight.

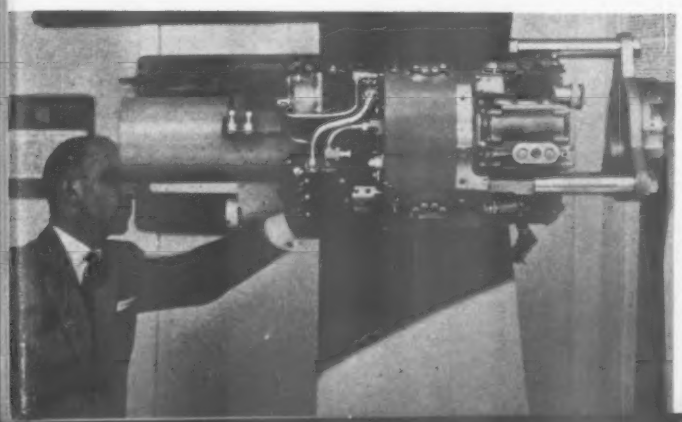
After the roll-stabilization phase comes the gathering phase, in which Seaslug is "gathered" into the guiding beam. This corrects the dispersion of the boost phase and brings the missile to the centre of the beam. In this period the control system actuates the control surfaces in pairs; one pair for yaw control, the other pair for pitch steering. The response of Seaslug is made high in this period because the missile is away from the beam centre and is steering to "fringe area" signals.

After "gathering" the missile enters the guidance phase, in which it is near the centre of the beam and receiving strong guidance signals. During this phase the response of the control system is reduced.

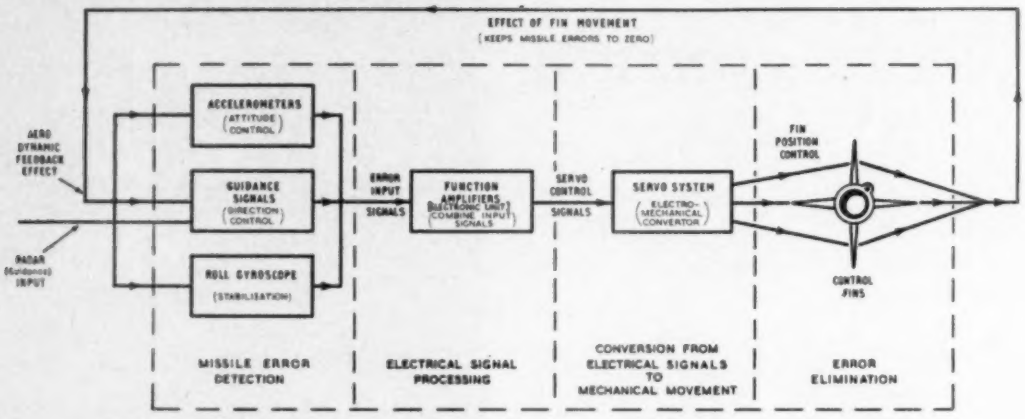
Since the beam is following a moving target, during the guidance phase the control system must maintain the missile's



SYSTEM LAYOUT.—Location of the control-system components in the missile body is shown right.



CONTROL RING.—Left, this ring which carries the actuators and control surfaces of Seaslug is exhibited at Farnborough.



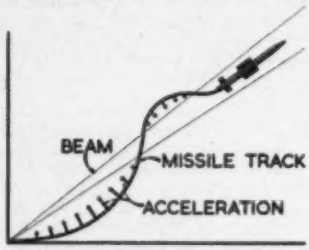
CONTROL LOOP.—The overall control loop indicates the principles of Seaslug's control system.

alignment with the beam. At the same time, any dispersions due to air turbulence and cross winds require correction.

The guidance phase continues until the interception phase, in which the target is destroyed.

Control-system Functions and Components

The functions of the control system are broadly expressed as: Switching the missile electrical system from "deck-borne" to "airborne"; timing the cycle of events in the flight of Seaslug; initiating the various stages of the cycle; providing a stable reference for roll stabilization; measuring missile accelerations; computing the control-surface deflections required to maintain alignment with the beam; operating the control surfaces; stabilizing the missile in pitch and yaw during the gathering and guidance phases; and adjusting the control-surface responses to maintain a constant control independent of atmospheric conditions.



SEASLUG GUIDANCE.—Typical acceleration demands made on Seaslug during its guidance phase are shown here.

In flight electrical power for the missile is provided by a gas-driven turbo-alternator. Before take-off power is supplied by the ship's electrical system. A rotary solenoid-operated change-over switch, forming part of the missile control system, switches from the external to internal supply.

The timing of the flight cycle and the initiation of its phases are the responsibility of the time and programme unit. A synchronous AC motor in this tiny unit drives a number of cams to operate the switches controlling the sequence of events.

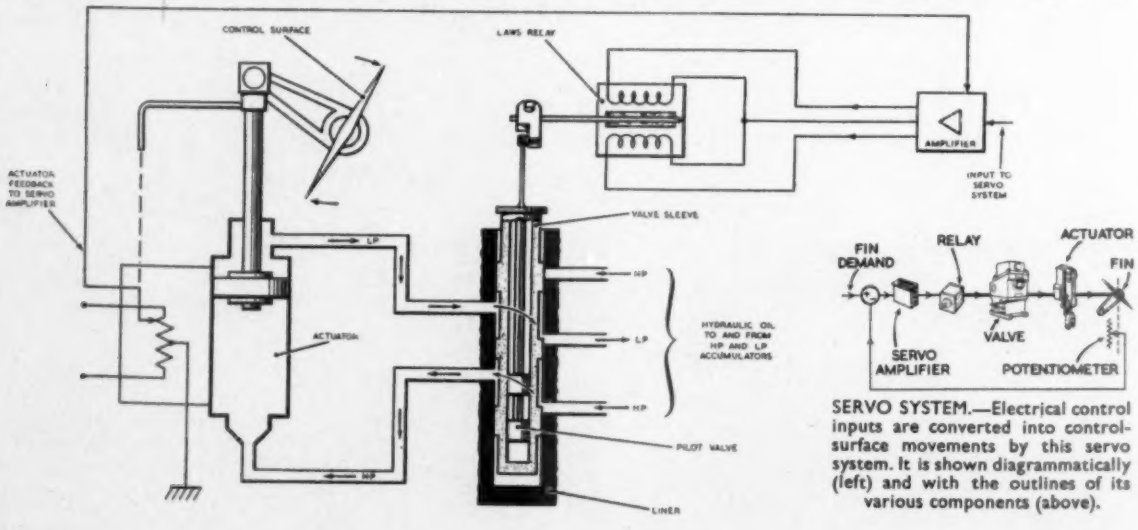
In the roll-stabilization phase the rolling motion of the missile is halted and the missile axes are aligned with those of the beam. The reference to which the missile is aligned is provided by the roll gyroscope. This is set up prior to flight and remains aligned with the reference axis of the radar beam.

When the roll-stabilization phase is switched in, roll error voltages from the gyroscope are applied to the missile control system and result in all four control surfaces being deflected in a like sense. This halts the rolling motion and, as the missile axes are aligned with the beam axes, the voltage from the gyroscope reduces and the control surfaces return to normal. Thereafter all four control surfaces move together only when necessary to correct a roll disturbance.

To correct a displacement of the missile from the beam, an aerodynamic force is applied by using the control surfaces as rudders and elevators. The necessary forces (or accelerations) are computed in terms of the guidance error-signals and are spoken of as acceleration demands.

An accelerometer in the front of the missile body measures the accelerations experienced by the missile. (Purpose of a second accelerometer, in the rear end of the missile body, is explained later.) The accelerometer contains electro-magnetic pick-offs in the pitch and yaw planes and measures the accelerations felt by the missile in these planes. Typical accelerations in pitch experienced by a missile are shown on this page.

The control computor is the "brain" of the missile. Its electronic amplifiers and computing networks interpret the guidance error signals and ensure that the required steering is applied to the missile. In addition, acceleration signals from the accelerometers, control-surface position signals from



SERVO SYSTEM.—Electrical control inputs are converted into control-surface movements by this servo system. It is shown diagrammatically (left) and with the outlines of its various components (above).

the control actuators and stabilization signals from the roll gyroscope are applied to this unit for interpretation.

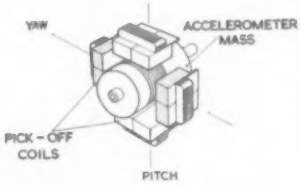
The electronic unit is an outstanding example of missile component packaging. The complete computor with its built-in power supply transformers and regulators operates from a single AC input supply and is contained in a can approximately 24 in. long and less than 6 in. dia.

The electrical signals from the computor are converted into control-surface deflections by electro-hydraulic servo systems. The hydraulic power is provided by a reciprocating pump, gas-driven in flight. An accumulator with high- and low-pressure compartments is fitted. The low-pressure section provides a reserve of hydraulic fluid; the high-pressure section smooths the pulsating delivery from the pump.

The electrical-hydraulic transition is effected in two valve blocks, each controlling one pitch and one yaw surface. Electro-magnetic transducers (Laws relays) with operating coils energized by the computor, position valves which control the hydraulic flow, as shown on page 186.

Four separate hydraulic actuators are provided to position the control surfaces. Each actuator carries a potentiometer which gives a signal to the computor showing the position taken up by the control surface. The actuators are linked to stub shafts on which the control surfaces are mounted. The actuators and other hydraulic components are mounted in a control ring in which the stub shafts and control surfaces are supported. When assembled into a complete missile, this ring forms part of the missile body.

One further major component of the control system is the aerodynamic stiffness unit which modifies the control-surface responses to compensate for variations in dynamic pressure. Potentiometers in this unit modify the signals in the control systems and are driven by bellows linked to a pitot tube in the missile's nose.



ACCELEROMETER.—Accelerations in the yaw and pitch planes are measured by this accelerometer after the missile has been roll-stabilised.

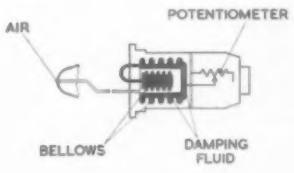
Problems of Control

From a control point of view, it is apparent that the missile must be told:—

(a) How far it is from the beam centre;

(b) In which direction it must move to reach the beam centre;

(c) Whether the required acceleration in the right direction has been achieved to bring the missile to the beam centre;



AERODYNAMIC STIFFNESS UNIT.—Operated by a pitot tube in the missile nose, this unit modifies control-surface responses to compensate for dynamic-pressure variations.

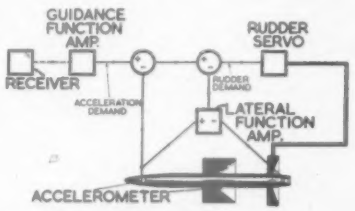
(d) Whether any lateral motions (i.e., weathercocking) are present. Also the atmospheric conditions surrounding the missile must be known so that the response of the control surfaces to a given signal from the beam can be made essentially constant at all speeds and altitudes.

The guidance receiver determines (a) and (b) from the radar beam and produces appropriate guidance signals for the control system. These are then applied to the computor which determines the accelerations needed for the missile to align with the beam.

Pitch and yaw accelerations of the missile are measured by the front accelerometer and compared with the accelerations demanded in the computor by the guidance received. If the measured acceleration is not as required, a signal by the computor to the electro-hydraulic servo system produces the required control surface deflection. As the missile approaches the beam centre the acceleration demand signal decreases. The control surface deflection then reduces until the measured acceleration balances. This is, of course, a continuing process but can only be described here stage-by-stage.

Were one accelerometer only to be fitted, it would be difficult to detect and counter possible angular accelerations of the missile about its centre of gravity. For this reason, a second accelerometer is fitted in the rear of the missile and produces electrical signals representing the accelerations in pitch and yaw which are felt at that position. These signals are compared with those of the front accelerometer and any unbalance (caused by, for example, "weathercocking") is determined by the computor and used to initiate corrective action by the control surfaces.

The overall control "loop" is illustrated on page 186; the external link from the control surface to the input is shown as aerodynamic feedback effect. The diagram shows the initial loop for roll stabilization (containing the roll gyroscope) and, above this, the guidance loop formed by the accelerometers (attitude control) and guidance signals (guidance control), together with the electrical signal processing carried out by the computor, the electro-mechanical conversion by the servo systems, and, finally, the control fin movement.



SIGNAL COMPARISON.—Guidance and accelerometer control signals are compared to produce missile movement.

Two considerations affect the amount of control surface-deflection applied to a missile in flight. These are its structural strength and variations in dynamic pressure. The structural strength determines the maximum permissible manœuvre.

Any given missile has a stress limit determined by its design and by the strength/weight ratio to which it has been constructed. In Seaslug any violent movements of the control surfaces which might cause the missile to encounter flight stresses for which it was not designed are prevented by electrically limiting the demand signals in the computor. The computor outputs representing acceleration demands (therefore the control surface deflections) are allowed to rise in response to the guidance demands until the safe limit is reached. The system is then held static until the demand reduces as correction is felt.

In order to make the missile responses independent of height and speed, the aerodynamic-stiffness unit modifies the inputs to the computor so that the control surface deflections for a given demand signal vary inversely with dynamic pressure.

Control System Testing

Guided weapons are inherently complex and expensive items of military equipment which demand precision components tested to ensure complete reliability and stability. In Seaslug production rigorous inspection and testing procedures are adopted for each component.

After thorough testing every unit is sealed, evacuated and pressurized before delivery. It is expected, ultimately, to introduce automatic testing of components to tolerance bands (as carried out in ship-borne installations) rather than the present diagnostic testing to specified figures.

The type testing of a Seaslug control system has been performed in specially equipped environmental test laboratories, capable of reproducing the variations of temperature, humidity, etc., experienced in service.

A dry-heat test is designed to reveal defects which may be caused by conditions of storage in desert areas. The damp-heat test, reproduces conditions found in tropical areas of high rainfall. Cold-weather, salt-corrosion and driving-rain tests are also made.

The control system for Seaslug is manufactured by the Sperry Gyroscope Co., Ltd., in their new factory at Bracknell, Berks. At Bracknell the various components are tested and packed for despatch to Armstrong Whitworth, where they are included in the complete missile assembly.

Seaslug is the product of considerable research and development; it has been flight-tested from land-based launchers and from the Navy's guided-weapons trial ship H.M.S. "Girdle Ness." The resultant accuracy and reliability has become well known. For example, last year in a salvo firing without warheads, the first missile destroyed the target whilst the second sought out and demolished the largest remaining piece of wreckage.

Personal Flying

The fundamental (if inevitable) difference between personal flying here and on the other side of the Atlantic was brought home sharply the other day with the announcement that the U.S. Federal Aviation Agency (which might be described as a hybrid equivalent of M.T.C.A. and A.R.B.) had placed a contract for the development and initial production of low-price and low-weight distance measuring equipment (DME) for executive aircraft.

Such a device, which, by pulse techniques, measures and presents distance from appropriately equipped ground stations, would not be much use to the private pilot over here, even if it were really low-priced, small, light and miraculously un-power-consuming. In America there are, at present, only 40 or so VOR transmitters modified to include the TACAN transponders which, making up the mysterious word VORTAC, provide the DME facility. And if there were VORTAC stations dotted all over this country and in Europe, distance-measuring information would hardly be the first requirement of the amateur invader of controlled airspace.

But the F.A.A. contract shows how the U.S. authorities think about the private owner and is interesting because of its tacit assumption that the more usual navigational aids are commercially obtainable and (as, in fact, they are) in normal, full-scale use.

Over here we should be glad enough, for a start, of commercially priced communication and automatic direction-finding equipment—which is all that one needs for getting about in controlled airspace pending the arrival of super-miniaturized Decca (offered at a peppercorn rental) with entirely automatic and fool-proof position-plotting, height-plotting and data-link facilities. The data link would keep ATC fully and continuously informed of the private owners' erratic progress, which would be corrected and adjusted by means of a few quiet words over the RT.

All that this owner would then require, apart from a change in ministerial policy, for a handsome and organized arrival at L.A.P. in zero-zero conditions would be some simple items of automatic approach and landing equipment. And, of course, a private-owners' runway well away from the rough-and-tumble of 10/28 R and L.

Maybe the controllers—kind and helpful enough when a VHF-equipped private aircraft is in real trouble—have quite a bit on their plates and are justifiably irritated by the prospect that still more may be added. When the private owner has shown by example that he is well-equipped, organized and capable of fitting happily and efficiently in to the traffic pattern—then he will be fitted in.

• • •

We hear from Rollasons that an increase in the price of their rebuilt Tiger Moths has become necessary. From September 1, orders for the standard Tiger Moth will be priced at £900, because of further and substantial increases in the cost of essential materials purchased from outside sources.

• • •

Some confusion about the British representation of the Italian Piaggio company has recently resulted from an unintentionally misleading press statement. The true position is that Aero-Enterprises (Boreham Wood), Ltd., is the exclusive U.K. representative for Piaggio, and no other British company is the sole sales concessionnaire. It is generally the policy of Aero-Enterprises, however, to sell through recognized aviation dealers and brokers.

McAlpine Aviation at Luton, the first purchaser of a Piaggio P.166, is one of these dealers, and has also an exclusive spares concession for Piaggio aircraft. The second British P.166, G-APVE, owned by the Earl of Derby, is now flying from Speke, having been procured through the services of W. S. Shackleton, Ltd.

Aero-Enterprises has announced that the 1960 Model P.166 will cost £31,610, f.a.f., excluding duty, in standard six-seat form, with toilet, buffet, and full blind- and night-flying equipment. Deliveries are scheduled to begin in March. A 10-seat convertible P.166, VH-PAP, was recently supplied to Papuan Air Transport, and left for Australasia on August 24, piloted by Capt. Van Santen.

Gliding Notes

by Dr. A. E. Slater

THIS is likely to turn out a record year for cross-country soaring in Britain. The main reason is evidently an accelerating increase in the number of pilots who can set out confidently on long distances, though the dry summer must have contributed its share. Even the "boulder clay" belt, left behind by the Ice Age, has dried out, though actually it seems to take quite a bit of rain to stop this clay from producing any thermals at all. Another factor is the Gold "C" badge, without which there would certainly be fewer 300-km. flights made, and the additional Diamond given for reaching a 300-km. goal results in many people covering this distance two or three times before landing at the right place.

Bristol Gliding Club boasts its first Diamond won by a club member, who took the Skylark 2 to Great Yarmouth on June 7. Then Peter Scott became the second with a similar flight on July 19, flying his new Olympia 419, and on the same day four other pilots landed only four miles short of Yarmouth: Tony Gaze (Eagle), Doug Jones (Olympia), Tony Morgan and Keith Aldridge (each in a Skylark 2). What with two other flights, to Lasham and Hungerford, the total distance covered from Nympsfield that day was nearly 1,100 miles.

Peter Scott, like the other Yarmouth aspirants, had first to be towed south-westwards so as to start from a point far enough from the goal. One pleasant feature of this large amount of cross-country wandering is that one keeps meeting other pilots along the route; Scott ran across Tony Morgan near Cheltenham, a strange Skylark near Buckingham, an Olympia from Cranfield over Bedford, and Aldridge near Newmarket, and finally Mike Gee, who nearly reached Yarmouth on a dog-leg course from Lasham. He (Peter Scott) met the sea-breeze front at Norwich, but it did not prevent the city from sending him up to 5,600 ft. in air which must have constituted the front itself, as clouds were forming below and around him. This put Yarmouth within easy gliding distance. It was his sixth attempt to get there, and it took him 6 hr. 9 min.

On the same day a visiting pilot, Tony Deane-Drummond, went round a 100-km. triangle, Nympsfield-Winchfield-Fairford-Nympsfield, at 43 m.p.h. average. Five days earlier, three Bristol pilots flew to Lasham, two of them returned to Nympsfield, and one of the two flew back to Lasham a second time, making three laps without landing.

• • •

AMONG flights from Dunstable on that outstanding day, July 19, were one of 171 miles by John Furlong in a Skylark 3 to Norwich and back as far as Henlow, and an out-and-return of 150 miles to Nympsfield and back by Colin Richardson in a Sky. Best of nine cross-countries on August 8 was 137 miles by Godfrey Lee to Chard and, at right-angles to him, 95 by Charles Ellis to Market Harborough. A week later, Geoffrey Stephenson was best of seven with 116 miles to Swindon and back, and next day best of seven again with 158 miles to Great Malvern and back, while Roger Mann made 146 miles on a crooked flight to Cambridge via Fairford.

On August 29 the London Club set Roborough, near Plymouth, 189 miles from Dunstable, as the day's goal, and it was reached by Roger Mann and Godfrey Lee; the same goal was attained the following day by John Everitt, the former chief instructor, and by Arthur Doughty, the London policeman, in his veteran Kite 2.

• • •

LASHAM had a particularly good week-end in early August, starting with an out-and-return two-seater record of 149 miles by D. J. Corbett and H. Hilditch to Evesham and back on the 7th.

Jill Walker with 101 miles from Lasham to Wellington (Somerset) put up a women's national record for New Zealand, where she comes from, while Don Snodgrass made half a mile less and Mike Gee went 112 miles to Tiverton, all on August 8.

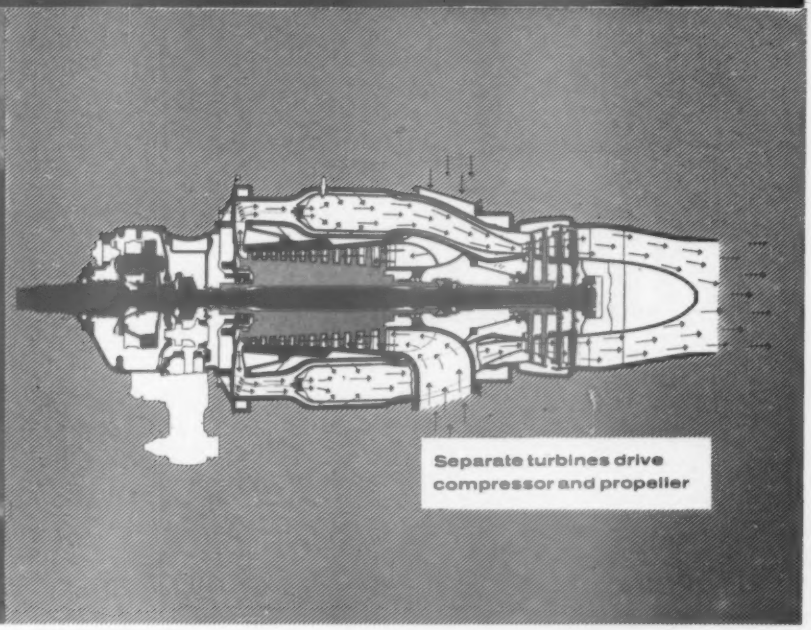
Cu-nims on August 9 lifted Doc. James to 13,500 ft. over Lasham, while at Andover three people in turn tried for the same cu-nim: L. Croshaw (13,000 ft.), B. Sharman (15,000 ft.) and then Frank Allen—but he was unfortunately towed to the wrong cloud.

Another July 19 flight was 190 miles from Camphill by Brian Jefferson, who gave Lympne as his goal but landed a few miles short, and yet another from there was 126 miles by Stan Armstrong to Stradishall.

Also worthy of mention is 199 miles by D. J. Corbett, from Lasham to Dunkeswell (Exeter) and back on August 4, and two attempts to reach Usworth (Newcastle-on-Tyne) from the Coventry Club by J. A. Findon and H. Greenway.

But the outstanding flight of the summer is undoubtedly a 300-km. flight in a Prefect—a "mere" training machine in the Grunau Baby Category. The pilot was W. Verling; he flew 190 miles from Hornchurch A.T.C. centre, via Stowmarket to Northcliffe (which I cannot find on the map), and he took only 5½ hours to do it on July 26.

Proteus 4,000-hp turboprop achieved 2,000 hours overhaul life in less than 2 years' service . . .



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The Bristol Siddeley Proteus 765 has improved even on the outstanding economy of the earlier versions. Although the total equivalent horsepower at take-off has been increased to 4,400, for an engine weight of only 2,900 lb, the cruising specific fuel consumption has been cut to 0.486lb/ehp/hr. And the more advanced Mark 770, now under development, has an even higher take-off power—4,615 ehp and an even lower cruise specific fuel consumption—0.476, for the same weight.

Profitability—Dependability—Adaptability

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The Proteus story, however, does not finish here. Proteus derivatives are designed to give the same outstanding service in marine applications and as powerplants for peak-lopping electrical generators.

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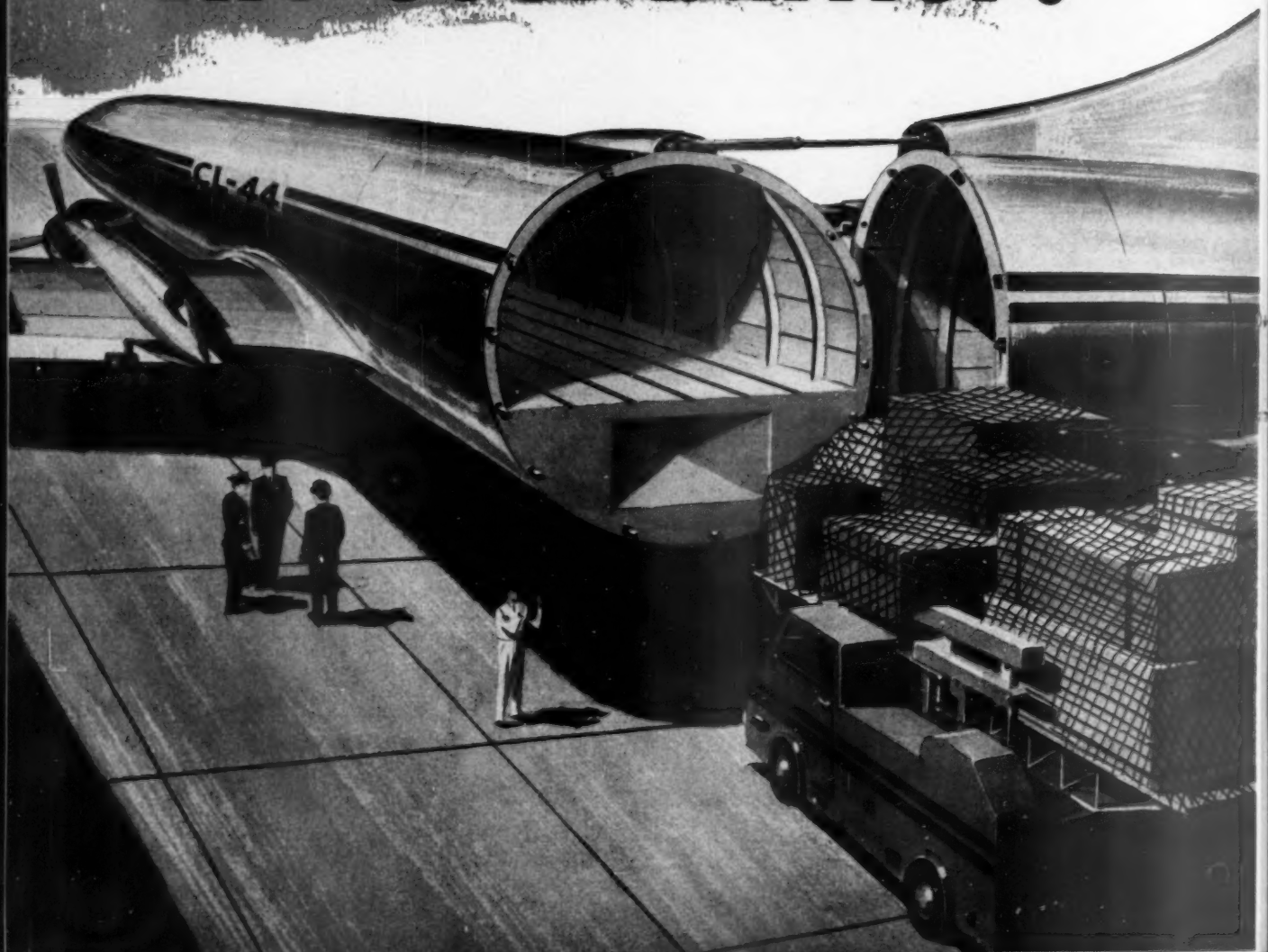

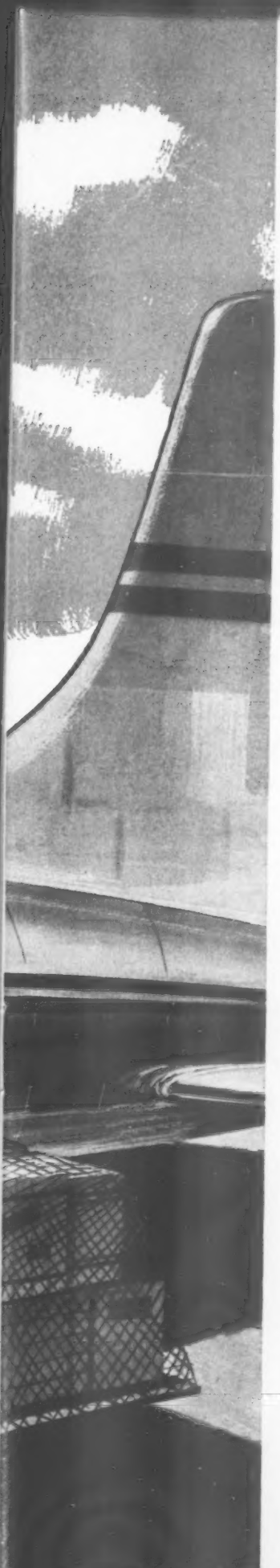

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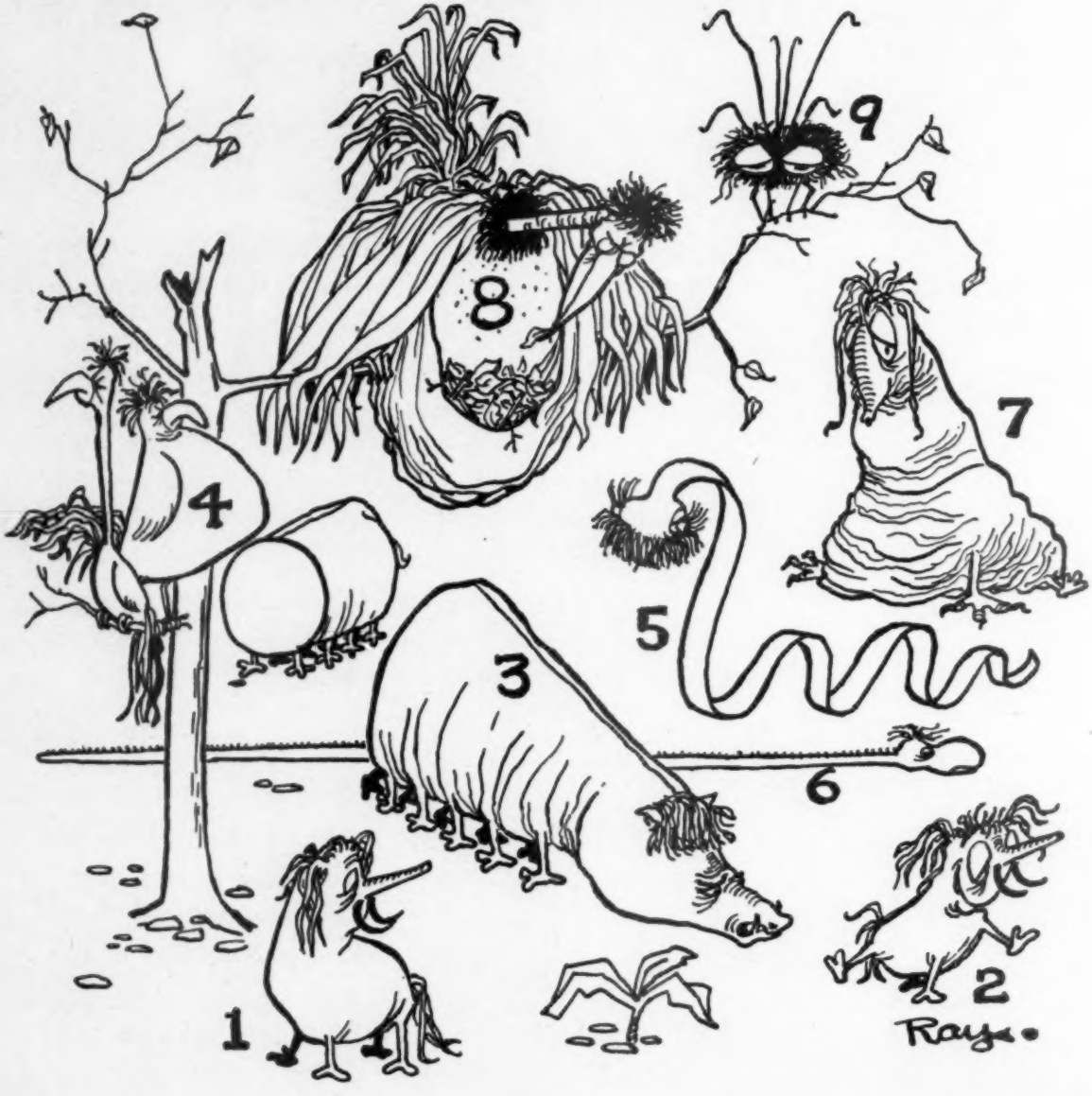

Key: 1, Weft. 2, Skewed Weft. 3, Cross Section of a Drogue.
4, Vanes. 5, Strop. 6, Static Line.
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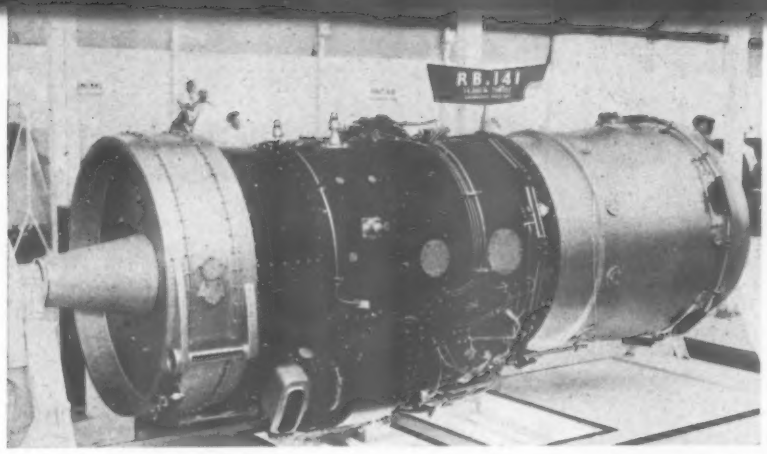


A full-scale engineering mock-up of the new Rolls-Royce RB.141 by-pass engine.

(*Continued from page 170*)

in I.S.A. + 30°C. tropical conditions. First ran February, 1957. Type test November, 1957.

Gnome H.1000.—The de Havilland Engine Co., Ltd. Licence-built version of the 1,000-s.h.p. General Electric T-58 free-turbine engine. First showing of an entirely British-built Gnome; this first ran on June 5, 1959. Engine shown as installed in Whirlwind and P.531 helicopters. To be type-tested this year and uprated to 1,250 s.h.p. by 1961. Engine is considerably cheaper than T-58; it has been specified as alternative to that engine for the Vertol 107 and Sikorsky T-58-engined helicopters.

Gnome P.1000.—The de Havilland Engine Co., Ltd. First showing at Farnborough of the 1,000-s.h.p. version of the Gnome. Development planned to give 1,150 s.h.p. and ultimately more than 1,400 s.h.p. Scheduled to run early 1960. Possible powerplant for the projected D.H. 123 transport and Scottish Aviation Twin Pioneer. 1,200-s.h.p. version on order for the Breguet 941 STOL transport.

Gyron Junior DGJ.1.—The de Havilland Engine Co., Ltd. 7,000-lb.-thrust engine with high percentage compressor air-bleed for boundary-layer control blowing. First ran August, 1956. Two Gyron Juniors power the Blackburn NA.39.

Gyron Junior DGJ.10.—The de Havilland Engine Co., Ltd. 10,000-lb.-thrust engine for Bristol 188 supersonic research aircraft. Thrust with reheat, 14,000 lb. Mach 2+ tests to be made in N.G.T.E. tunnel, Pyestock. First ran October, 1957.

Leonides Major.—Alvis, Ltd. Helicopter version designed for mounting at any angle. In service with R.A.F. Whirlwind 7s, Austrian Air Force S-55s and for Queen's Flight Whirlwind 8s. Maximum rated power, 795 b.h.p. First ran June, 1955.

Leonides 530 Series.—Alvis, Ltd. Long-stroke Leonides, rated at 625 b.h.p., which powers the Series 3 Scottish Aviation Twin Pioneer. First ran October, 1957. Type test August, 1958.

Leonides 554/1.—Alvis, Ltd. Helicopter powerplant designed for vertical installation. Maximum rated power, 635 b.h.p. Weight, 790 lb.

Napier Helicopter Booster.—D. Napier and Son, Ltd. Components of the Napier rotor-tip rocket-booster units for helicopters. HTP is decomposed by catalyst to give thrust. Can give 66 rotor s.h.p. on Skeeter and 90 rotor s.h.p. on Whirlwind.

Olympus BOl.7R.—Bristol Siddeley Engines, Ltd. Olympus with Bristol Siddeley Solar fully-variable reheat giving total thrust 24,000 lb. Olympus BOl.7 Mk. 201 powers Vulcan B.2 bomber. Type-tested at 17,000-lb. thrust. Advanced reheat Olympus has delivered 33,000-lb thrust. Developed Olympus chosen for TSR-2.

Orpheus BOr.12.—Bristol Siddeley Engines, Ltd. First British showing of the 6,810-lb.-thrust military Orpheus 12, latest in Orpheus series. Engine has simplified reheat giving 8,170 lb. for take-off. Civil version has two-position nozzle giving 7,200 lb. for take-off and lower cruise s.f.c. First ran December, 1958. Now being type-tested at 6,500-lb thrust.

Palas 600.—Blackburn Engines, Ltd. Basic gas generator of the Blackburn range of gas-turbine power units. Shown sectioned. As pure turbojet gives 390-lb. thrust. First ran February, 1954.

Proteus 765.—Bristol Siddeley Engines, Ltd. Sectioned 4,400-e.h.p. powerplant of the latest civil and R.A.F. Britannias. Cruise s.f.c. 0.486 lb./e.h.p./hr. More powerful Proteus 770 under development has 4,615 e.h.p. take-off power and 0.476 lb./e.h.p./hr. cruise consumption. First ran July, 1957. Type test July, 1957.

Rolls-Royce RB.108.—Rolls-Royce, Ltd. Two of these jet-lift engines displayed as mounted in Short SC.1 VTOL aircraft, which has four RB.108s for lift and one for propulsion. Maximum thrust, 2,010 lb. with control air bleed; thrust/weight ratio approaches 10. Engines pivot 30° fore and aft for acceleration and deceleration of SC.1.

Rolls-Royce RB.141.—Rolls-Royce, Ltd. Full-scale engineering mock-up of the 14,300-lb. thrust RB.141. Two-spool by-pass engine with air-cooled turbine blades. Production deliveries from early 1962. Engine scheduled for first run next month. Engines of the RB.141 by-pass family have thrusts from 10,000 to 17,500 lb. Production deliveries of the 10,100-lb. RB.163 for the D.H. 121 airliner will begin at end of 1962.

Rolls-Royce RB.145.—Rolls-Royce, Ltd. High-thrust/weight-ratio turbojet based on RB.108. Thrust 2,750 lb. Supersonic military version and civil version with anti-icing to A.R.B. requirements have been studied.

Sapphire ASSa.7R.—Bristol Siddeley Engines, Ltd. Engine with afterburner as installed in Gloster Javelin FAW.8 and FAW.9. Engine without reheat powers earlier Javelins and Handley Page Victor B.1. Take-off thrust, 11,000 lb. Reheat thrust increase is 12%. First ran July, 1952. Type test at 10,570 lb., June, 1957.

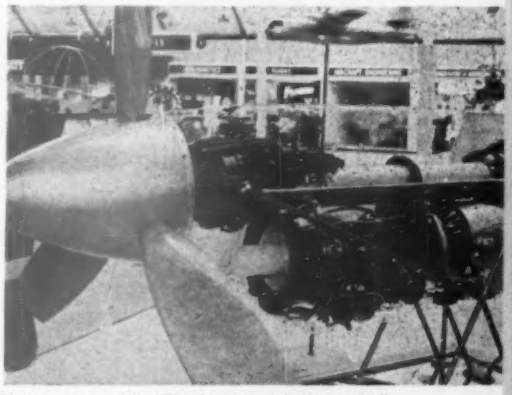
Scorpion (Single and Triple).—D. Napier and Son, Ltd. Single and triple chambered versions of the HTP/kerosene Scorpion rocket motor. Thrusts are 2,500-3,000 lb., and 7,000-9,000 lb. respectively. Current projects cover Scorpion installation in F-86 Sabre fighters and in an Australian super-sonic target missile. One Canberra with Double Scorpion is in R.A.F. service.

Thor BT.1.—Bristol Siddeley Engines, Ltd. Sectioned Thor of type from which the BT.2 Thor powering the Bloodhound SAM was developed. First showing in cut-away form of Britain's only production ramjet. Thrust above 16,500 lb. at Mach. 3 at sea level. First ran (BT.1) late 1954.

Turmo 600.—Blackburn Engines, Ltd. Powerplant of the Mk. 1 Saunders-Roe P.531 and Kaman K.17 helicopters. Free-turbine unit driving through two-stage gear-box; one-hour rating, 425 s.h.p.; weight, 310 lb. Has industrial application as power unit of lightweight emergency generating set. First ran June, 1955. Type test December, 1956.

Tyne RTy.1.—Rolls-Royce, Ltd. 5,525 e.h.p. version of the two-spool Tyne turbo-prop as installed in the Vickers Vanguard. Canadair CL-44 freighter has 5,730 e.h.p. RTy.12s. First ran June, 1957.

Viper ASV.11.—Bristol Siddeley Engines, Ltd. In production for the Jindivik 3 target drone and Macchi MB.326 trainer. Weighs 500 lb. and delivers 2,500-lb. thrust. Later ASV.12 gives 2,700-lb. thrust. First ran January, 1957.



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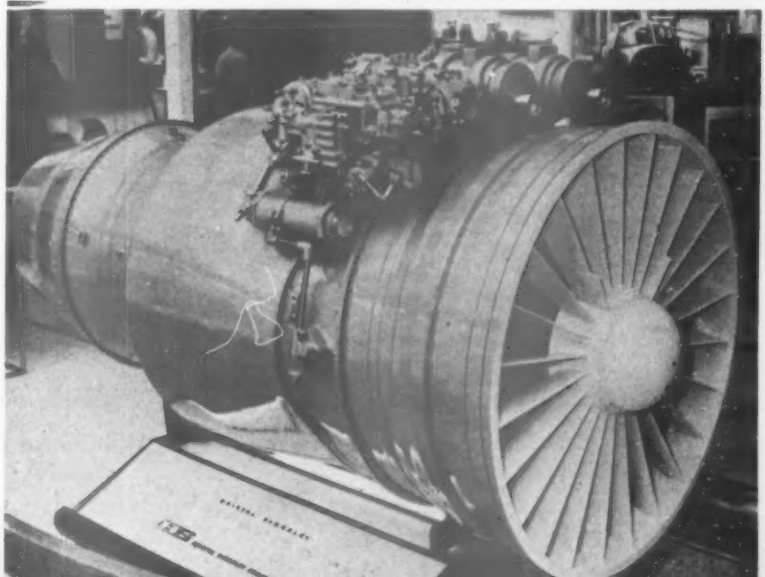
Making its Farnborough début was the little de Havilland Gnome in turboprop form.



Bristol Siddeley's new ducted-fan engine, the BE.58.

Farnborough

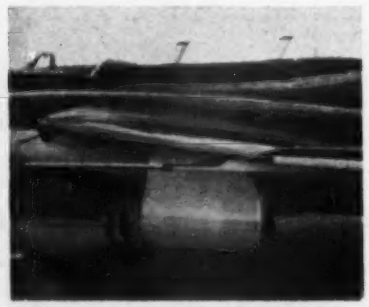
First Report . . . .

All the Aircraft Displayed

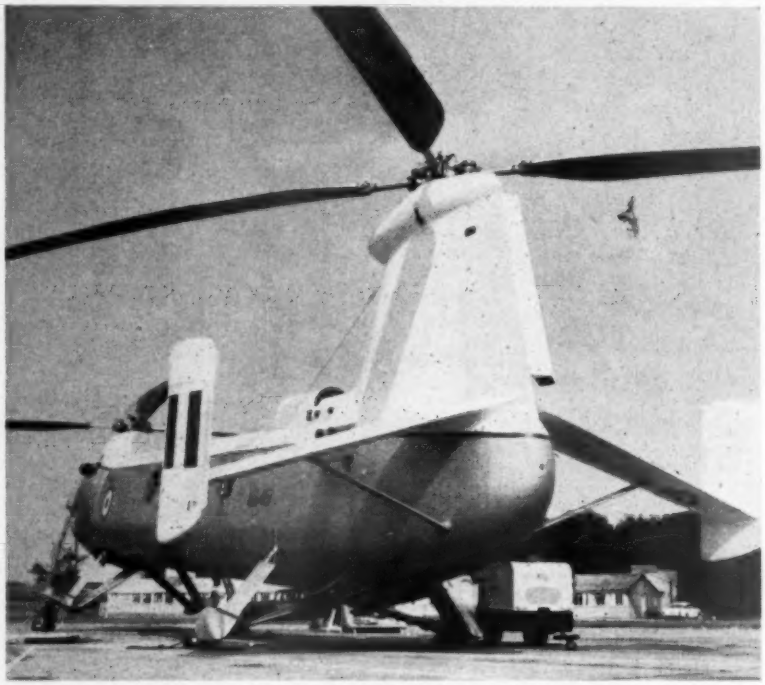
Armstrong Whitworth A.W. 650 Argosy. G-APRN and G-APVH. Four 2,100-e.h.p. Rolls-Royce Dart 526 (RDa 7/2) turboprops. The fourth and fifth Argosies, respectively, of the pre-production batch of ten. The first Argosy flew on January 8, 1959. In the static park, the A.W.A. roller-mat loading system is demonstrated on G-APVH. A strip fairing at the rear of the fuselage fixes the flow break-away point and, in conjunction with the vortex generators at the rear of the cabin, reduces buffet experienced in certain flight conditions.

Auster J/5L Aiglet Trainer. G-APVG. One 145-b.h.p. de Havilland Gipsy Major 10/2. A standard production Aiglet Trainer, making its seventh appearance at an S.B.A.C. Display.

Avro 694 Lincoln 2. G-APRJ. Four 1,750-b.h.p. Rolls-Royce Merlin 68 engines. This aircraft is used by Napier for icing research and has recently completed icing clearing tests on the Caravelle wing a section of which is mounted vertically on the fuselage. A Blackburn Palouste in a ventral fairing provides a source of hot air for anti-icing systems and compressed air to vaporize water for the spray system. Tests have also been made on the Caravelle tail and Britannia, Beverley and Comet wings.



Two close-ups of the N.A.39 showing (top) the wing vortex generators and (bottom) the tail layout with new arrangement of dive-brake fairing strakes.



Photographs copyright "The Aeroplane and Astronautics"

A rear view of the Bristol Type 192; it now has a new fin trailing edge and spats on the rear wheels.

Avro 698 Vulcan B.2. XH536. Four 17,000-lb.s.t. Bristol Siddeley Olympus 201 turbojets. A production Mk. 2. The prototype Vulcan 2 flew on August 31, 1957, and the first production aircraft (XH533) in August, 1958. Has a constant frequency 200-volt A.C. electrical system, and is capable of starting its powerplants without the aid of ground equipment.

Avro Conway - Vulcan. XA902. Four 17,250-lb.s.t. Rolls-Royce Conway R.Co.11s. A production Vulcan 1 re-engined to serve Rolls-Royce as an engine test-bed. This is the second Conway-Vulcan.

Blackburn N.A.39 (B.103). XK490. Two 7,000-lb.s.t. de Havilland Gyron Junior DGJ.1s. The fifth of the pre-production batch of 20 N.A.39s, of which seven have now flown.

Bristol 192. XG451. Two 1,650-s.h.p. Napier Gazelle 100 (N.Ga.2) shaft turbines. The fourth of a batch of 30 Bristol 192s in production for the R.A.F. The first flew on July 5, 1958. The first squadron is to form next year. The example on show is furnished partly as a troop carrier and partly as an ambulance. Also shown is the alternative winch-carrying door; the two A.S.R. containers which can be carried one each side of the rear fuselage; and the two 274-gallon auxiliary tanks which can be carried internally. New mods. are the "trouser" fairings on the front and rear undercarriage legs; spats on the rear wheels, and a wedge-shaped fairing on the trailing-edge of the fin to improve directional stability.

de Havilland D.H.104 Dove 6. G-AMZN. Two 380-b.h.p. de Havilland Gipsy Queen 70 Mk. 2 engines. The company demonstrator furnished as a six-seat executive, in the static park only. The Dove first flew on September 25, 1945 and has appeared at every S.B.A.C. Display since 1946.

de Havilland D.H.106 Comet 4B. G-APMB. Four 10,500-lb.s.t. Rolls-Royce Avon 525B turbojets. The second of seven B.E.A. Comets, with lengthened fuselages and shorter wings, without pinion tanks. The first 4B flew on June 27, and completed 100 hr. by mid-August; the second flew on August 17. The 4B exhibited is furnished as an 86-seater, with 24 first class and 62 tourist class seats.

de Havilland D.H.110 Sea Vixen FAW.1. XJ-516. Two Rolls-Royce Avon-200 series turbojets. Production aircraft, carrying four Firestreaks and two 150-gallon tanks, and with flight refuelling probe in the port wing.

de Havilland D.H.114 Heron 2. G-APEV. Four 250-b.h.p. de Havilland Gipsy Queen 30 Mk. 2 engines. A series 2D, with custom-built interior and fully-feathering airscrews.

de Havilland D.H.115 Vampire T.11. XD624. One 3,500-lb.s.t. de Havilland Goblin 35 turbojet. Standard production aircraft, shown in static park, with the new R.A.F. trainer aircraft fluorescent red finish on nose, tail and wing tips.

de Havilland D.H.C.2 Beaver 2. G-ANAR. One 540-b.h.p. Alvis Leonides 502/4. The Canadian-built Beaver demonstrator, with the British Leonides engine, is making its fifth S.B.A.C. appearance. Its participation in the flying display reflects current British Army interest which may lead to the Beaver being built in Britain.

English Electric Canberra P.R.9. XH134. Two Rolls-Royce Avon 206s. One of the Short-built production Canberra 9s, on show for the first time. A new feature of this version is the hinged nose containing navigator's station and Martin-Baker Mk. 4 lightweight ejection seat beneath a frangible panel.

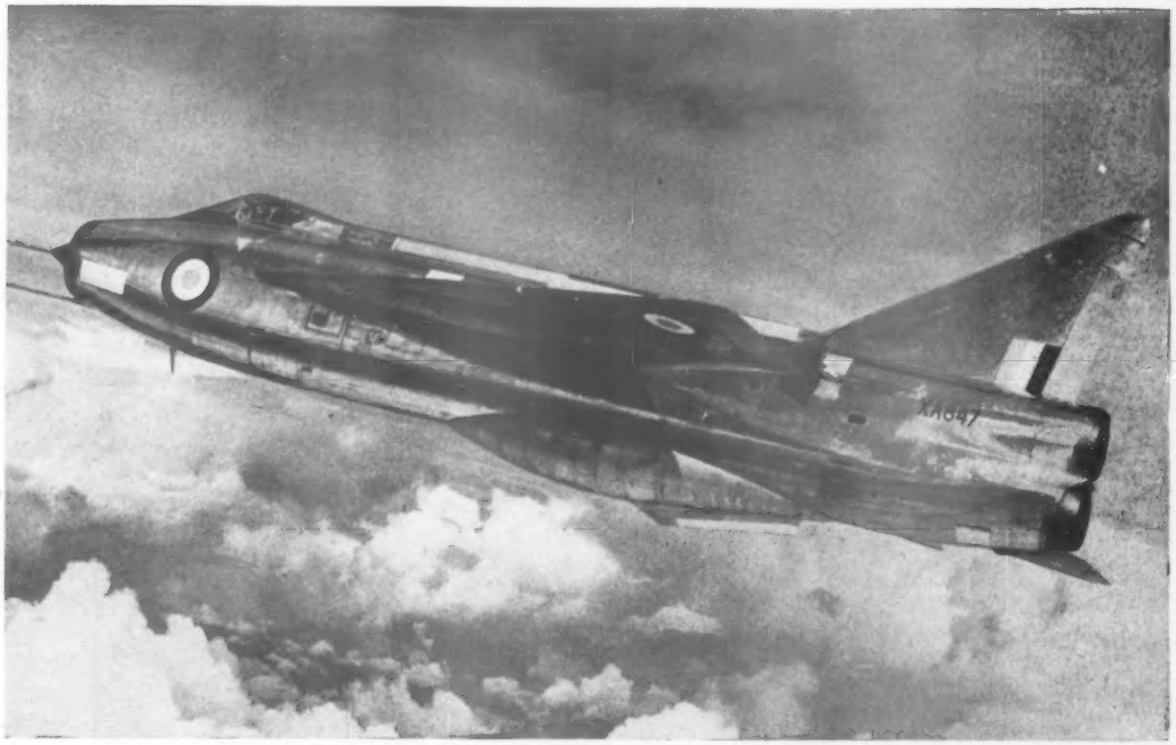
English Electric P.1B Lightning F.1. XG331. Two Rolls-Royce Avon 200 series turbojets with re-heat. The last of the pre-production aircraft from the first batch of 20 Lightnings. Shown as a completely equipped weapon system, with Airpass radar, two de Havilland Firestreak AAMs, two Aden guns, and ventral tank.

(*Continued on page 191*)

WINGS DAY SEPT. 19th GIVE FOR THOSE WHO GAVE

AS A PIECE OF APPLIED AERODYNAMICS...

Over the whole of its phenomenal speed range—far more than 10 to 1—from its moderate landing speed, through subsonic and transonic speeds, up to its very considerably supersonic maximum, the ENGLISH ELECTRIC Lightning is inherently aerodynamically stable. Without any assistance from electronics it is at all speeds free from pitch-up.



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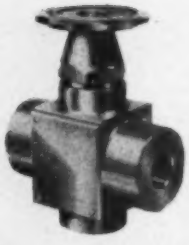
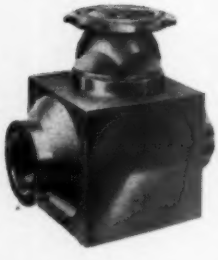
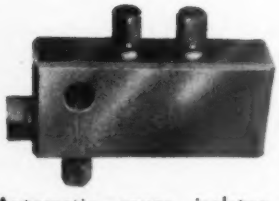
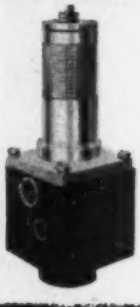


HP Balanced stop and needle valves. Full range of sizes.





Automatic gauge isolator. Full range 0-6000 p.s.i.



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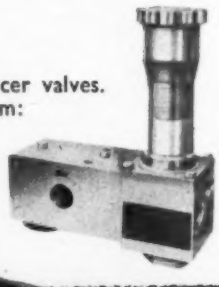
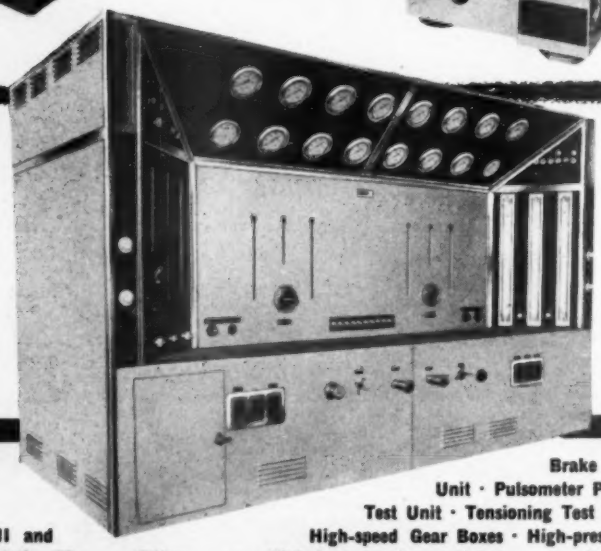


All types of special hydraulic test equipment built to users' own requirements. The unit shown was supplied to a large aircraft company.

FARNBOROUGH AIR SHOW COVERED STAND No. 1-OUTSIDE EQUIPMENT EXHIBITION



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Aircraft Displayed . . . .

(*Continued from page 190*)

English Electric P.11 Lightning T.4. XL628. Two Rolls-Royce Avon 200-series turbojets with re-heat. The two-seat Lightning trainer, first flown on May 6, 1959, is in production for the R.A.F. and differs from the Lightning F.1 only in the front upper fuselage. Full operational radar and armament can be carried by the P.11, which is shown carrying two Firestreaks and ventral fuel tank.

Fairey Rotodyne. XE521. Two 3,000-e.h.p. Napier Eland N.El.3 turboprops. The prototype, which first flew on October 25, 1957, and made its first full transition in April, 1958. Since its previous S.B.A.C. appearance, the Rotodyne has been modified to have decreased incidence on the wings, and ailerons have been fitted to improve lateral control. The upper portions of the tail fins have also been made vertical except when folded on the ground.

Fairey Gannet AEW.3. XL452. One 3,875-e.h.p. Bristol Siddeley Double Mamba 102. The fourth production example of the Navy's new early warning aircraft, soon to start Service trials with 700G Squadron. Prototype first flew on August 20, 1958, and first production Gannet 3 on December 2, 1958. The first deck-landing trials were made on H.M.S. "Centaur" by the prototype XJ440 on November 18, 1958, and more complete trials on H.M.S. "Victorious" by XL451, the third production aircraft, on May 6, 1959. The second production Gannet 3 went to Idris for tropical trials on July 2, 1959.

Folland FO.144 Gnat Trainer. XM691. One 4,230-lb.s.t. Bristol Siddeley Orpheus 100 (B.Or.4). The first of 14 Gnat Trainers for evaluation by the R.A.F., first flown on August 31, 1959, and totalling 10¼ hr. in 18 flights when it arrived at Farnborough. Compared with the Gnat 1, the trainer has 30% more wing area, a longer fuselage and larger tail unit. It also has outboard, instead of inboard, ailerons, and separate flaps. Folland Mk. 4G ejection seats are fitted with combined parachute and seat harnesses. Gross weight is just over 6,000 lb.

Folland FO.141 Gnat 1. XN326. One 4,520-lb.s.t. Bristol Siddeley Orpheus 701 (B.Or.2). A standard production Gnat 1 purchased by the M.o.S. for continuing development flying.

Gloster Javelin FAW.8. XJ125. Two 12,300-lb.s.t. Bristol Siddeley Sapphire 200-series (A.S.Sa.7) turbojets with re-heat. Standard production Javelin as shown last year with four Firestreaks.

Handley Page HPR-7 Dart Herald. G-AODF. Two 2,105-e.h.p. Rolls-Royce Dart 527 (R.Da.7/2) turboprops. The second prototype Herald converted to Dart engines, making its first appearance at an S.B.A.C. Display, in B.E.A. markings, after extended tours earlier this year in the Middle East, India, Pakistan and South America.

Hawker Hunter T.7. XJ615. One 8,000-lb.s.t. Rolls-Royce Avon 122. The prototype two-seat Hunter trainer, now used by the E.T.P.S., shown in the static park with the nose of a single-seat Hunter 6 alongside, together with representative armament loads.

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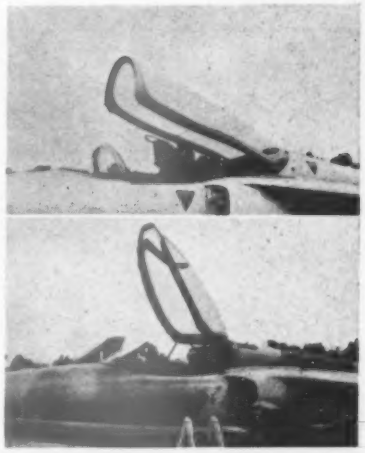
Maxaret brakes are fitted to the Hunter T.66A nosewheel; note also the new gun blast tube.



Gnat canopies — top, the trainer version and, bottom, the single-seater type.

Hawker Hunter FGA.9. XG135. One Rolls-Royce Avon 203. This is the prototype of the new ground-attack Hunter ordered by the R.A.F. for service in the Middle East and first flown on July 3, 1959. Based on the F.6, it is fitted with an 8-ft. ring-slot landing parachute, and is shown carrying 24 rockets with 12-lb. heads and two 230-gallon Hawker mild steel tanks. Each tank contains a fuel contents gauge (calibrated in lb.) visible from the cockpit.

Hawker Hunter T.66A. G-APUX. One Rolls-Royce Avon 203. A company demonstration model of the Hunter two-seater as produced for the Indian Air Force. This version is based on the Hunter 6, and has two 30-mm. Aden guns, whereas the R.A.F. and R.N. Hunter trainers are based on the Mk. 4 and have only one cannon. Experimental features are the Dunlop Maxaret brake on the nose-wheel and the larger (13 ft. 6 in.) ring-slot tail parachute, to give the optimum short-landing performance.

Hunting P.84 Jet Provost 2. G-AOUS. One 2,500-lb.s.t. Bristol Siddeley Viper A.S.V.11. A development aircraft, as shown last year, with 40% more power than the standard production Mk.3. Max. gross weight is 7,150 lb. with full tip-tanks.

Hunting P.84 Jet Provost T.Mk.3. XM370. One 1,750-lb.s.t. Bristol Siddeley Viper 102 (A.S.V.8). A production model Jet Provost in the static park, in the new fluorescent markings for R.A.F. trainers. Deliveries to the R.A.F. began on June 26, 1959.

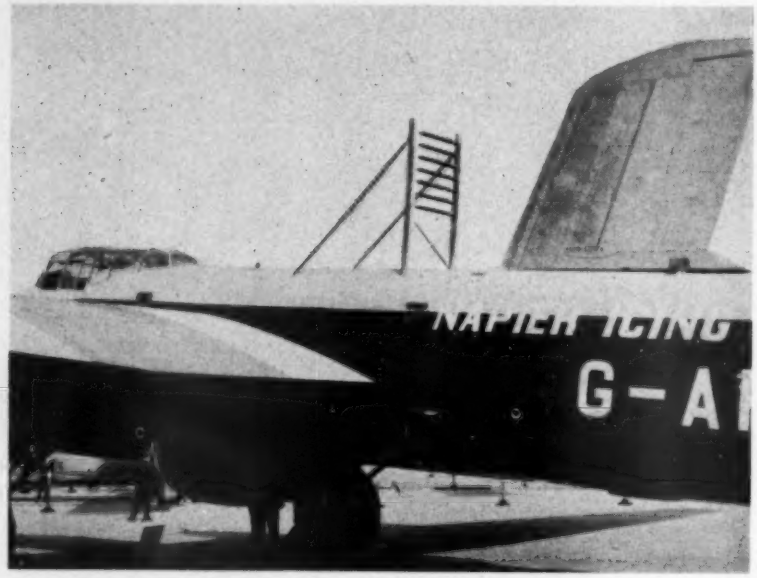
Hunting P.84 Jet Provost T.Mk.51. CJ701. One 1,750-lb.s.t. Bristol Siddeley Viper 102 (A.S.V.8). This is the armed, export version of the Jet Provost for the Royal Ceylon Air Force. Exhibited in the static park with representative armament of four rockets and four practice bombs on each wing, and two 0.303 machine guns in the intakes. The nose contains a gun camera, landing and formation lights.

Hunting P.66 President 2. G-APVJ. Two 540-b.h.p. Alvis Leonides 514 engines. A new company demonstrator, replacing G-AOJG shown previously. Furnished as 12-seater.

Saunders-Roe P.531. G-APVL. One 650-s.h.p. Blackburn A.129 turbine. The third P.531 to fly (on August 9, 1959), this prototype has many modifications compared with the first two Turmo-engined P.531s shown last year. Apart from the new engine, there is a new transmission system, skid u/c instead of wheels, revised rear boom and rotor pylon and new cabin. Also in the static park, G-APVM, similar to G-APVL but with a derated de Havilland

The Saro Skeeter 12 with external stretchers.

Aircraft Displayed . . . .



A portion of the Caravelle wing and spray gear mounted on a Lincoln and used by Napier for icing clearance tests for the French aircraft.

Gnome H.1000 turbine. This has a rear-mounted gearbox and a disc brake on the transmission shaft.

Saunders-Roe SRN-1 Hovercraft. G-12-4. One 435-b.h.p. Alvis Leonides engine, driving a four-blade fixed-pitch axial fan. Since its first "flight" on June 1, 1959, the SRN-1 has been modified by the addition of a "bow" to improve its sea-going characteristics. Gross weight is 8,500 lb. and present cruising speed is 25 knots.

Saunders-Roe P.501 Skeeter. AOP.12. One 220-b.h.p. de Havilland Gipsy Major turbo-supercharged engine. A development Skeeter for the Army with external stretcher carriers.

Scottish Aviation S.A.B5 Twin Pioneer. G-AOER. Two 540-b.h.p. Leonides 514/8 engines. The fifth production Twin Pioneer, specially modified to the order of Rio Tinto Finance and Exploration for geophysical surveys. Carries electro-magnetic detection equipment in special wing-tip Fibreglass "fins," on extended mainplanes. The fairings can be rotated to provide variable axes of the coils.

Vickers - Armstrongs Vanguard 951. G-APEB. Four 5,525-e.h.p. Rolls-Royce Tyne 506 (RTy.1) turboprops. The third of three Vanguards which have flown since January 20, 1959, and the second of 20 for B.E.A. This one flew on July 23 and shows the new B.E.A. colour scheme as well as the small dorsal fin introduced since the Vanguard flight trials started. The front and rear cabins are finished in B.E.A. style and the centre cabin is instrumented for tropical trials, which are to start soon. In recently-completed flight resonance tests, the Vanguard was flown at a true air speed of 530 m.p.h. at 18,000 ft.

Vickers - Armstrongs Viscount 816. VH-TVR. "John Murray." Four 1,990-e.h.p. Rolls-Royce Dart 525 (RDa.7/1) turboprops. One of two Series 810s which may be ordered by Trans-Australia Airlines and styled and furnished to this operator's requirements, with orange anti-collision paint on fin and rudder, wing tips and spinners. Rear lounge, 44-seat (four-abreast) main compartment and eight-seat forward compartment. Airstairs at forward entry.

Westland W.B.5 Wessex HAS.1. XM301. One 1,800-s.h.p. Napier Gazelle 160 (NGa.13) shaft turbine. Production anti-submarine aircraft for the Royal Navy exhibited with ventral bomb slip for external loads. First production Wessex flew June 20, 1958.

Westland Westminster. G-APLE and G-APTX. Two 2,400-e.h.p. Napier Eland 229 shaft turbines. The protoype "utility" model of the Westminster first flew on June 15, 1958, and the second first flew on September 4, 1959. Both now have up-rated Elands, which in G-APTX are fully cowled. The original Bristol Freighter wheels of the first prototype have been changed to smaller specialized units, with a saving of about 300 lb. in weight. The fuel tanks in G-APTX have also been relocated from their interior tandem position to external mountings on each side of the fuselage. For the flying crane rôle, this is a floorless framework, except for a small cabin aft.

Multiple flotation bags and a new skid undercarriage on the Widgeon.

Westland W.A.5 Whirlwind. XJ398. One 1,050-s.h.p. derated de Havilland Gnome H.1000 turbine. This Whirlwind first flew on February 28, 1959, and is the first turbine-powered Whirlwind. Also participating in the flying display is G-AOCZ, a standard S.55 Series 2 with Leonides Major 755/1 piston engine. Gross weight is 7,800 lb.

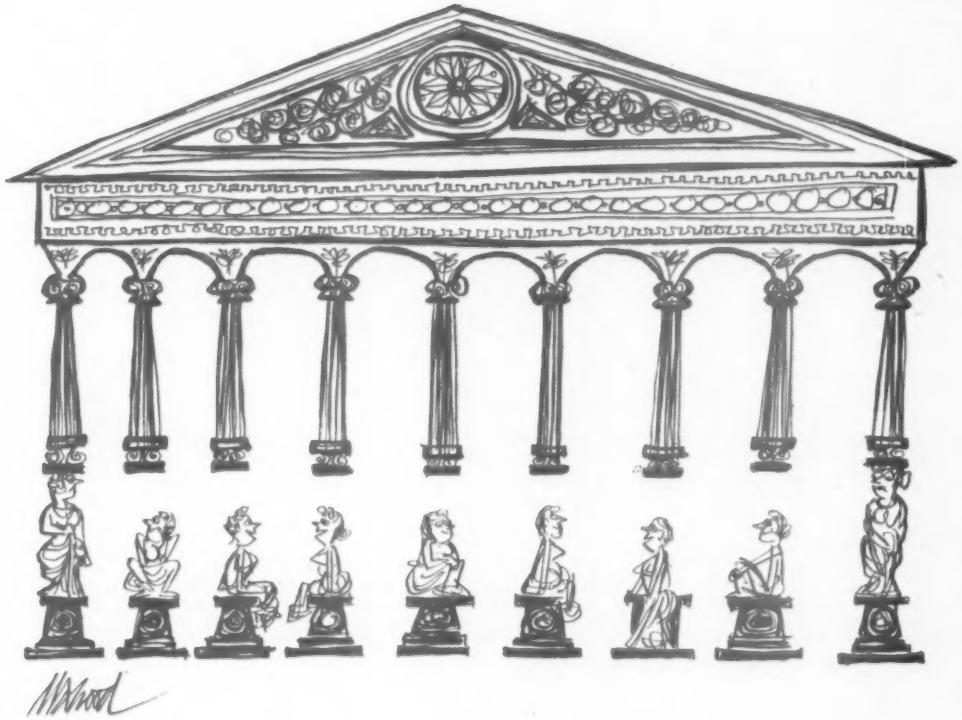
Westland W.B.1 Widgeon. G-ANLW. One 515-b.h.p. Alvis Leonides 521/2 piston engine. A production five-seat Widgeon demonstrator, fitted with a new skid undercarriage, incorporating multiple flotation bags.

R.N. Displays. (See page 197.) The Royal Navy contributes an aerobatic team of four Vickers-Armstrongs 544 Scimitar F.1s from No. 807 Squadron (Lieut.-Cdr. K. A. Leppard, R.N.). An additional demonstration is given by a Scimitar operating in the tactical reconnaissance rôle, with the alternative nose carrying oblique cameras. This flies past at 450 knots at runway level, on one engine, photographing the airfield, and the prints are displayed 30 minutes after the sortie is completed.

R.A.F. Displays. (See page 198.) The R.A.F. contributes four items to the flying programme, with representation from Fighter, Bomber, Transport and Flying Training Command. No. 111 Squadron, Fighter Command (Sqn. Ldr. Peter Latham) flies its aerobatic team of 14 Hunter F6s from Farnborough and the two Jet Provost T.1s from the C.F.S. are also Farnborough-based for their synchronized aerobatic display. A mixed bomber/fighter fly-past is provided by three Handley Page Victor B.1s from No. 15 Squadron; three Avro Vulcan B.1s from No. 230 O.C.U.; three Gloster Javelin FAW.2s from No. 46 Squadron and three Javelin FAW.7s from No. 25 Squadron. A Transport Command fly-past includes each type of transport in service—Bristol Sycamore HR.14 (J.E.H.U.), Westland Whirlwind HAR.2 (J.E.H.U.), Scottish Aviation Twin Pioneer CC.1 (No. 21 Squadron), Blackburn Beverley C.1 (No. 47 Squadron), Handley Page Hastings C.1 (No. 24 Squadron), de Havilland Comet C.2 (No. 216 Squadron), and Bristol Britannia C.1 (No 99 Squadron).

A close-up of the Vanguard's tail showing its dorsal fin.

Sailplanes. On the three public days, a sailplane demonstration is being given by well-known British gliding pilots. The gliders to be shown are the Elliotts Olympia 403 and Olympia 419; Slingsby Eagle; Slingsby Skylark 2; and Slingsby Skylark 3. The tow aircraft are a Messenger and a Tiger Moth.



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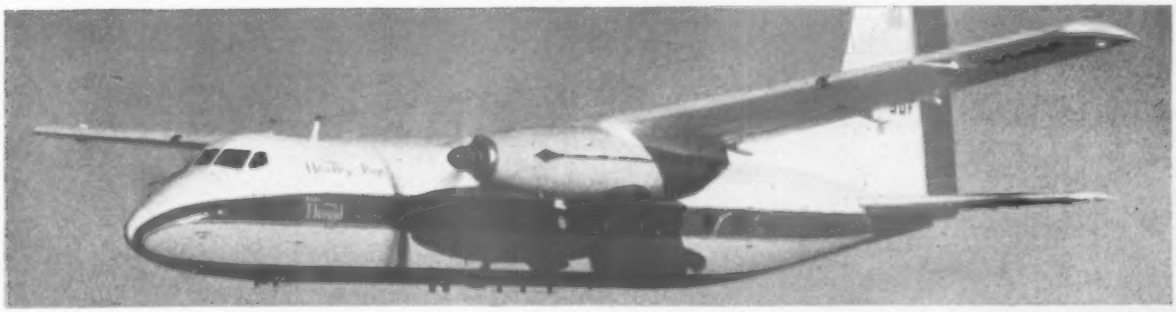

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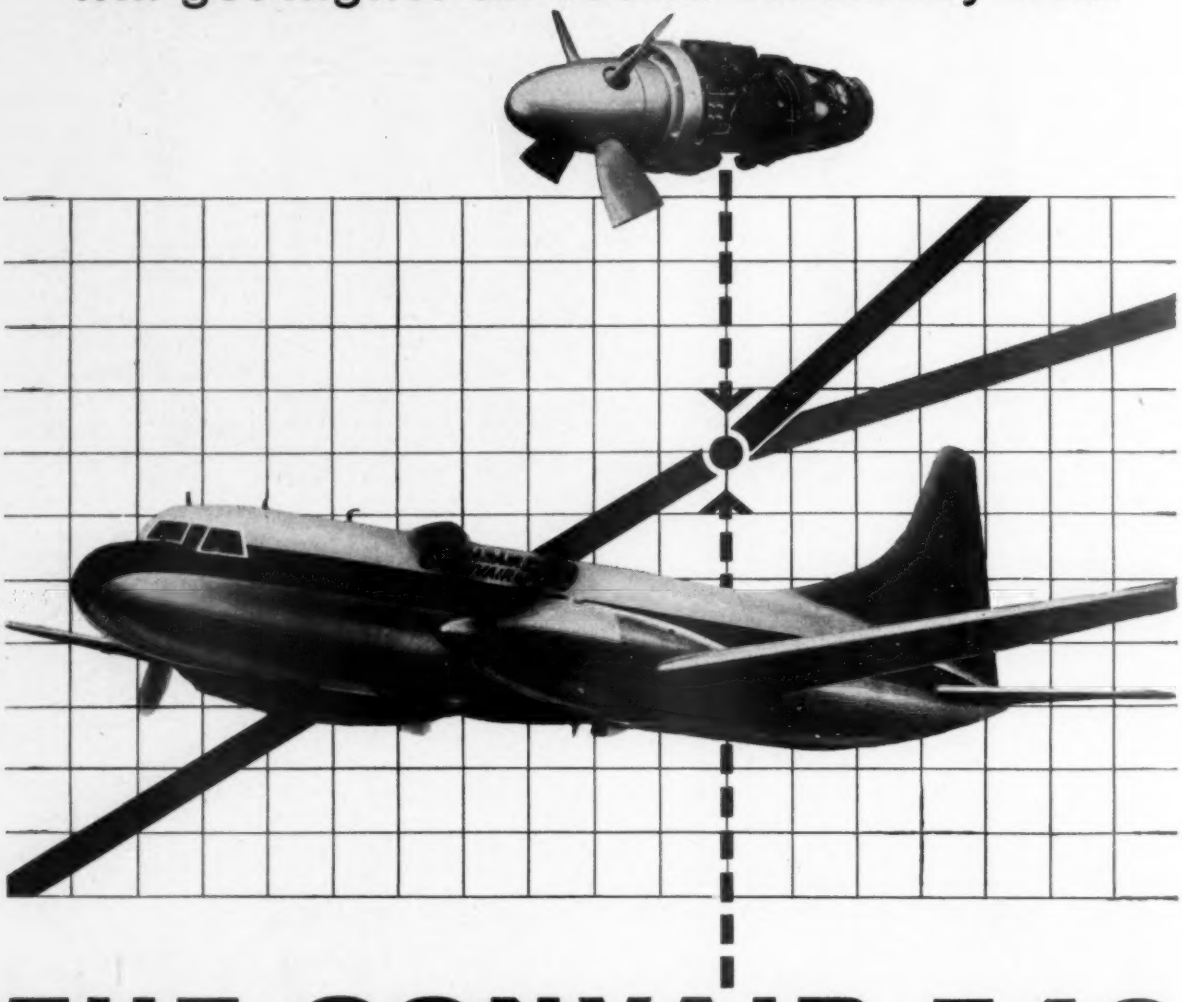

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Farnborough First Report . . .

Pilots Taking Part

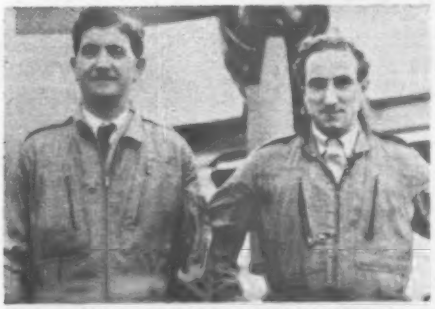
Some 65 pilots from eighteen companies are demonstrating the aircraft taking part in the flying displays at Farnborough throughout the week of the show. Here we give brief notes on their careers and indicate the aircraft they are flying

J. W. Allam.—Deputy chief test pilot, Handley Page, Ltd. Born, 1924. Joined R.A.F.V.R., 1942. Took E.T.P.S. course in 1950 and went to "B" Squadron, A. and A.E.E., Boscombe Down, 1951-53. Joined Handley Page, 1954.—Dart Herald.

P. Baker.—Test pilot, Handley Page, Ltd. Born, 1925. Joined R.A.F., 1943. Took E.T.P.S. course, 1953. At A. and A.E.E. Boscombe Down, 1954-56. Tutor at E.T.P.S., 1957-59. Joined Handley Page, 1959.—Dart Herald.

P. Barlow, D.S.C.—Development test pilot at Christchurch, de Havilland Aircraft Co., Ltd. Born, 1926. Joined R.N., 1942. Took E.T.P.S. course, 1953. Naval Test Squadron, A. and A.E.E. Boscombe Down, 1954-57. Seconded to de Havilland, 1957. Joined company, 1958—Sea Vixen.

Above, J. W. Allam; above right, R. P. Beamont; right P. Bugge.



Above, G. R. Bryce and E. B. Trubshaw.

A. R. Barnard.—Test pilot, Rolls-Royce, Ltd. Born, 1922. Joined R.A.F., 1942; transferred to Fleet Air Arm, 1944. Served until 1946 and then took four-year extended service commission. Joined Rolls-Royce, 1952.—Conway Vulcan.

R. P. Beamont, D.S.O. and Bar, O.B.E., D.F.C. and Bar, D.F.C. (U.S.A.).—Manager, flight operations, and chief test pilot, English Electric Aviation, Ltd. Born, 1920. Joined R.A.F., 1938. Attached to Hawker Aircraft as production and experimental test pilot, 1941-42 and 1943-44. Joined Gloster Aircraft as assistant experimental test pilot, 1945. Joined English Electric as chief test pilot, 1947. —P.11.

A. W. Bedford.—Chief test pilot, Hawker Aircraft, Ltd. Born, 1920. Joined R.A.F., 1940. O.C. instrument weather flight, E.T.P.S., 1949. Tutor at E.T.P.S., 1950, and R.A.E. test pilot 1950-51. Joined Hawker as experimental test pilot, 1951.—Hunter T.66 and Hunter FGA.9.

A. Blackman.—Test pilot, A. V. Roe and Co., Ltd. Born, 1928. Joined R.A.F., 1948. Took E.T.P.S. course, 1954 and served with "B" Squadron at A. and A.E.E., Boscombe Down until 1956 when he joined Avro.—Vulcan.

J. Blair.—Experimental and production test pilot, Scottish Aviation, Ltd. Born, 1916. Joined R.A.F., 1940. Left R.A.F. in 1946 and joined Scottish Aviation in 1947 as airline captain in Yorks and C.47s.—Twin Pioneer.

R. N. R. Bradley.—Assistant chief test pilot, Westland Aircraft, Ltd. Born, 1920. Joined R.N., 1941 and served with F.A.A. until 1946. Chief test pilot, Helliwells, Ltd. before joining Westland as experimental test pilot, 1950.—Wessex.

G. R. Bryce, O.B.E.—Chief test pilot Vickers-Armstrongs (Aircraft), Ltd. Born, 1921. Joined R.A.F., 1939. Was pilot in the King's Flight. Joined Vickers-Armstrongs as test pilot in 1946; became chief test pilot, 1951.—Vanguard.

P. O. Bugge.—Chief development test pilot at Hatfield, de Havilland Aircraft Co., Ltd. Born, 1918. Joined Royal Norwegian Air Force, 1939. Joined R.A.F., 1941. Went to Scandinavian Airline System as pilot, 1946. Joined de Havilland, 1949.—Comet 4B.

J. G. Burns.—Test pilot, Blackburn Aircraft, Ltd. Born, 1928. Joined R.A.F., 1945. Took E.T.P.S. course, 1954 and then went to A. and A.E.E., Boscombe Down. Left R.A.F., 1958, and joined Hunting Aircraft, Ltd. as test pilot. Joined Blackburn, 1959.—N.A.39.

C. A. Capper.—Chief test pilot, Airspeed Division, de Havilland Aircraft Co., Ltd. Born, 1923. Joined R.A.F., 1942. Took E.T.P.S. course, 1948. Test pilot in Aero Flight R.A.E. Farnborough, 1949-52. Joined Bristol Aeroplane Co., 1953 and went to de Havilland as experimental test pilot later same year.—Sea Vixen.

N. J. Capper.—Flight manager and chief test pilot, Scottish Aviation, Ltd. Born, 1907. Served in R.A.F., 1929-34 and 1939-44. Pilot with Hillman Airways and Imperial Airways, 1934-35. Returned to Scottish Aviation, 1945.—Twin Pioneer.

R. E. Clear.—Development test pilot, Airspeed Division, de Havilland Aircraft Co., Ltd. Born, 1917. Joined Airspeed, Ltd., 1936. Appointed test pilot, 1940. Took E.T.P.S. course, 1945. Became development test pilot, 1957.—Sea Vixen.

D. A. S. Colvin.—Test pilot, Westland Aircraft, Ltd. Born, 1921. Joined R.A.F., 1940 and served until 1946. Went to Scottish Aviation as airline pilot after leaving R.A.F. Joined Westland, 1949.—Westminster, G-APTX.

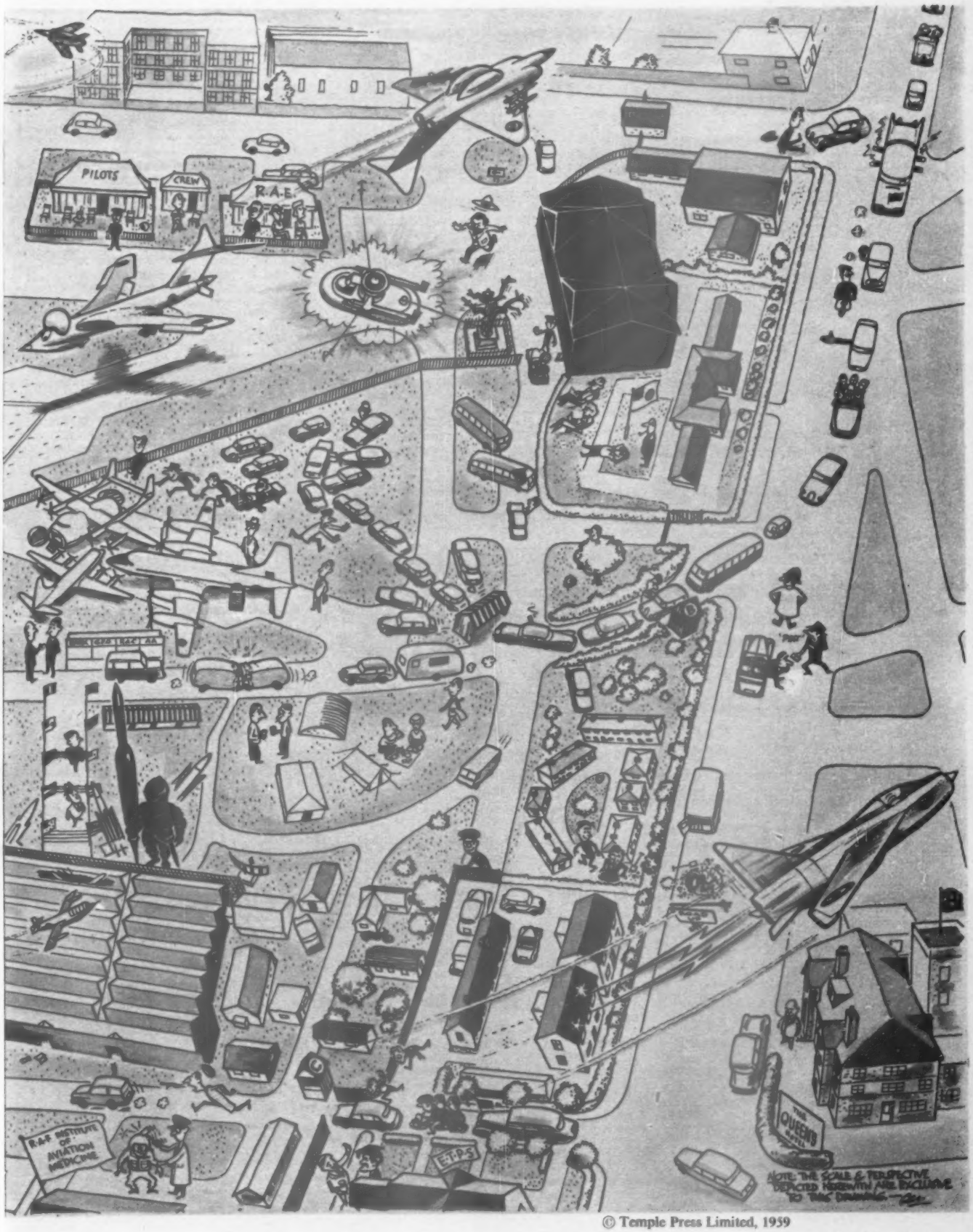
R. R. Crayton.—Test pilot, Westland Aircraft, Ltd. Born, 1922. Joined R.N., 1941. Helicopter course, 1952, and instruction duties, 1953-54; served in Malaya 1954-55. Night flying and instrument flying trials with No. 701 R.N. Air Squadron, 1957-58. Joined Westland, 1958.—Leonides-Major Whirlwind.

J. Cunningham, D.S.O. and 2 Bars, O.B.E., D.F.C. and Bar, D.L.—Chief test pilot and director, de Havilland Aircraft

(*Continued on page* 196)

Left, W. R. Gellatly; above, left to right, D. de Villiers, J. G. Harrison, A. J. Heyworth, and C. T. D. Hosegood; right, P. M. Lamb.

Farnborough First Report . . .



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(*Continued from page* 193)

Co., Ltd. Born, 1917. Joined de Havilland as student, 1935. Started test flying, 1938. Served in R.A.F. during War. Became chief test pilot, 1946, and was appointed to board in 1958.—Comet 4B.

L. de Vigne, A.F.C.—Test pilot, Westland Aircraft, Ltd. Born, 1915. Served with R.A.F., 1940-51. Took E.T.P.S. course, 1947. Service and civilian test pilot at R.A.E. Farnborough, 1948-52. Armstrong Siddeley Motors' chief test pilot, 1952. Joined Westland 1953.—Gnome-Whirlwind.

D. de Villiers.—Assistant chief test pilot, English Electric Aviation, Ltd. Born, 1923. Joined R.A.F., 1941. Seconded to de Havilland as test pilot, 1944. Left R.A.F., 1946, and joined de Havilland Propellers as chief test pilot. Joined English Electric, 1955.—Lightning.

S. B. Oliver and K. M. Reed.

J. S. Fay.—Test pilot and chief flying instructor, Westland Aircraft, Ltd. Born, 1921. Joined Fleet Air Arm, 1940. With B.E.A. Helicopter Unit, 1947-52. Joined Westland, 1952.—Widgeon.

T. M. S. Ferguson.—Senior production test pilot, English Electric Aviation, Ltd. Born, 1932. Began flying with R.A.F., 1950. Joined English Electric, 1955.—Lightning.

W. P. L. Fillingham, A.F.R.Ae.S.—Development test pilot, de Havilland Aircraft Co., Ltd. Born, 1914. Joined de Havilland as student, 1936. Appointed test pilot, 1939. Seconded to D.H. Canada, 1943, and D.H. Australia, 1944.—Comet 4B.

E. G. Franklin, D.F.C., A.F.C., A.R.Ae.S.—Chief test pilot, Sir W. G. Armstrong Whitworth Aircraft, Ltd. Born, 1920. Joined Armstrong Whitworth as apprentice, 1937, and R.A.F.V.R., 1939. Test pilot with Handley Page and Boscombe Down, 1942. E.T.P.S. course, 1944, and test flying at Boscombe Down. Rejoined Armstrong Whitworth, 1945.—Argosy.

W. R. Gellatly.—Chief helicopter pilot, Fairey Aviation Co., Ltd. Born, 1920. Joined R.N.Z.A.F., 1940; commissioned 1941. Received permanent commission R.A.F., 1947. Took E.T.P.S. course, 1950. Helicopter Flight commander, A. and A.E.E. Boscombe Down, 1951-54. R.A.F. Staff College, 1954-55. Joined Fairey Aviation, 1955.—Rotodyne.

J. C. Hall.—Test pilot, English Electric Aviation, Ltd. Born, 1928. Joined R.A.F., 1948. Took C.F.S. course, 1953. Joined English Electric, 1955.—Lightning.

J. G. Harrison, A.F.C.—Chief test pilot, A. V. Roe and Co., Ltd. Born, 1918. Joined R.A.F., 1935; commissioned, 1942. Took E.T.P.S. course, 1949. Test pilot with Aero Flight, R.A.E. Farnborough, 1950-52. R.A.F. Staff College, 1953. Joined Avro as test pilot, 1954. Appointed chief test pilot, 1958.—Vulcan.

H. G. Hazeldon, D.F.C. and Bar.—Chief test pilot, Handley Page, Ltd. Born, 1915. Joined R.A.F.V.R., 1939; commissioned, 1941. Took No. 1 course at E.T.P.S. at Boscombe Down. Commanded Heavy Aircraft Test Squadron, A. and A.E.E., Boscombe Down, 1945. Joined Handley Page as test pilot, 1947 and was appointed chief test pilot same year.—Dart Herald.

A. J. Heyworth, D.F.C. and Bar.—Chief test pilot, Rolls-Royce, Ltd. Born, 1922. Joined R.A.F., 1940. Joined Rolls-Royce, 1944 and appointed chief test pilot in 1954.—Conway Vulcan.

P. Hillwood.—Test pilot, English Electric Aviation, Ltd. Born, 1920. Joined R.A.F.V.R., 1938. Test pilot with Supermarine, 1948. Joined English Electric, 1949.—Lightning.

C. T. D. Hosegood.—Chief helicopter test pilot, Bristol Aircraft, Ltd. Born, 1921. Joined R.N., 1939. Helicopter flying training course in U.S.A., 1944. Went to A.F.E.E. Beaulieu, as experimental helicopter pilot. Joined Bristol, 1948.—Bristol 192.

J. K. Isherwood.—Production test pilot and communications pilot, English Electric Aviation, Ltd. Born, 1932. Began flying with R.A.F. in 1952. Joined English Electric, 1956.—Lightning.

J. J. M. Jeffrey.—Helicopter test pilot, Saunders-Roe, Ltd. Born, 1922. Joined Fleet Air Arm, 1940. Helicopter instructors' course in U.S.A., 1944. Helicopter instructor and senior helicopter test pilot Air/Sea Warfare Development Unit. 1945/46. Joined Saunders-Roe, 1950.—P.531.

D. M. Knight.—Test pilot, English Electric Aviation, Ltd. Born, 1931. Began flying with R.A.F., 1949. With No. 603 (City of Edinburgh) Sqn., R.Aux.A.F., 1951-54. Joined English Electric, 1953.—Lightning.

W. H. Sear and E. A. Tennant.

P. M. Lamb, D.S.C. and Bar, A.F.C.—Chief test pilot (fixed-wing aircraft), Saunders-Roe, Ltd. Born, 1923. Joined Fleet Air Arm, 1941. Took E.T.P.S. course, 1951. Naval Test Squadron, A. and A.E.E. Boscombe Down, 1952. Joined Saunders-Roe, 1958.—Hovercraft.

R. Martin, D.F.C. and Bar, A.F.C.—Chief test pilot, Gloster Aircraft Co., Ltd. Born, 1918. Joined R.A.F., 1937. Took E.T.P.S. course, 1945. Flight Commander, S.M.E. and Aero Flights, R.A.E. Farnborough, 1947-50. Instructor at E.T.P.S., 1950. Air Ministry, 1952-53. Joined Gloster, 1954.—Javelin FAW.9.

J. O. Mathews, D.S.O., D.F.C.—Test pilot, Fairey Aviation Co., Ltd. Born, 1921. Joined R.A.F., 1940. Liaison officer with U.S.A.A.F. night-fighter squadron, 1943. Instructor to Night Fighter Leaders School, C.F.E., 1945. Joined Fairey Aviation, 1946.—Gannet AEW.3.

H. G. H. Merewether.—Deputy chief test pilot, Hawker Aircraft, Ltd. Born, 1924. With Fleet Air Arm, 1943-46. Joined Hawkers as test pilot in 1954.—Hunter FGA.9 and Hunter T.66A.

R. Morris.—Test pilot, Fairey Aviation Co., Ltd. Born, 1924. Joined R.A.F., 1943; transferred to R.N., 1944. Joined Fairey Aviation, 1952. Took E.T.P.S. course, 1953.—Gannet AEW.3.

J. G. P. Morton.—Helicopter test pilot, Fairey Aviation Co., Ltd. Born, 1925. Joined R.N., 1943; commissioned, 1944. At A. and A.E.E. Boscombe Down, 1952-54. Joined Fairey Aviation, 1955.—Rotodyne.

P. Murphy.—Test pilot, Handley Page, Ltd. Born, 1927. Joined R.A.F., 1945; qualified as pilot, 1947. Went to Vickers-Armstrongs as experimental test pilot, 1951. Joined Handley Page, 1958.—Dart Herald.

M. Oliver.—Test pilot, Folland Aircraft, Ltd. Born, 1922. Joined R.A.F., 1939 and R.Aux.A.F. at Biggin Hill, 1947. Joined Folland as test pilot in 1957.—Gnat Mk. 1.

S. B. Oliver.—Chief test pilot, Hunting Aircraft, Ltd. Born, 1924. Joined R.A.F., 1942; commissioned, 1945 and transferred to R.N. Took E.T.P.S. course, 1950. Naval Test Squadron A. and A.E.E., Boscombe Down, 1951-52. Joined Hunting Aircraft, 1954.—Jet Provost.

J. R. S. Overbury.—Test pilot, Hunting Aircraft, Ltd. Born, 1925. Joined R.N., 1943. Took E.T.P.S. course, 1953. Naval Test Squadron, A. and A.E.E. Boscombe Down, 1954-56. Joined Saunders-Roe as development test pilot for S-R.53, 1956. Joined Hunting Aircraft, 1959.—Jet Provost.

G. R. I. Parker, D.F.C. and Bar, A.F.C., D.S.M.—Experimental test pilot, Blackburn Aircraft, Ltd. Born, 1918. Joined R.A.F., 1934. Test pilot at R.A.E., 1945. Joined General Aircraft in 1948.—N.A.39.

H. Phillips.—Helicopter test pilot, Saunders-Roe, Ltd. Born, 1918. Joined R.N., 1934; commissioned, 1943. Helicopter flying course, 1949. Helicopter test pilot at A. and A.E.E. Boscombe Down, 1955-58. Joined Saunders-Roe, 1958.—Skeeter.

G. H. Pike.—Experimental test pilot, de Havilland Aircraft Co., Ltd. Born, 1916. Joined de Havilland as apprentice, 1934. Commissioned R.A.F.V.R., 1939. Test pilot, de Havilland Engine Co., 1940-42. Test pilot with D. H. Aircraft Co. since 1942.—Beaver.

R. L. Porteous.—Sales director and chief test pilot, Auster Aircraft, Ltd. Born, 1916. Joined R.A.F. Reserve, 1937. Instructor and junior test pilot, Philips and Powis, 1938-39. President, Central Examination Board, Rhodesian Air Training Group, 1944-45. C.F.I. and secretary, Derby Aero Club, 1947-48. Joined Austers, 1948—Aiglet.

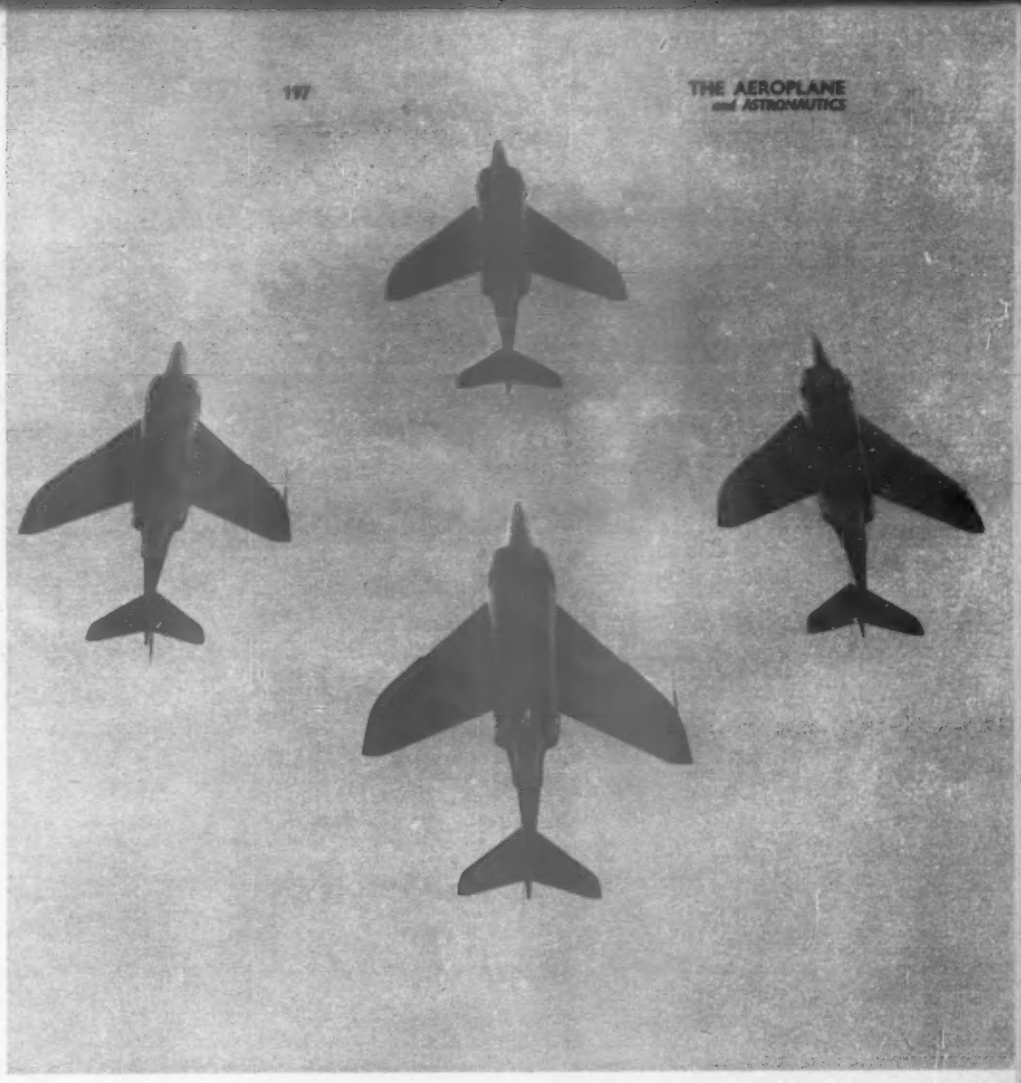
K. M. Reed.—Chief test pilot, Saunders-Roe, Ltd. Born, 1921. Served with Imperial Airways and joined

(*Continued on page 201*)

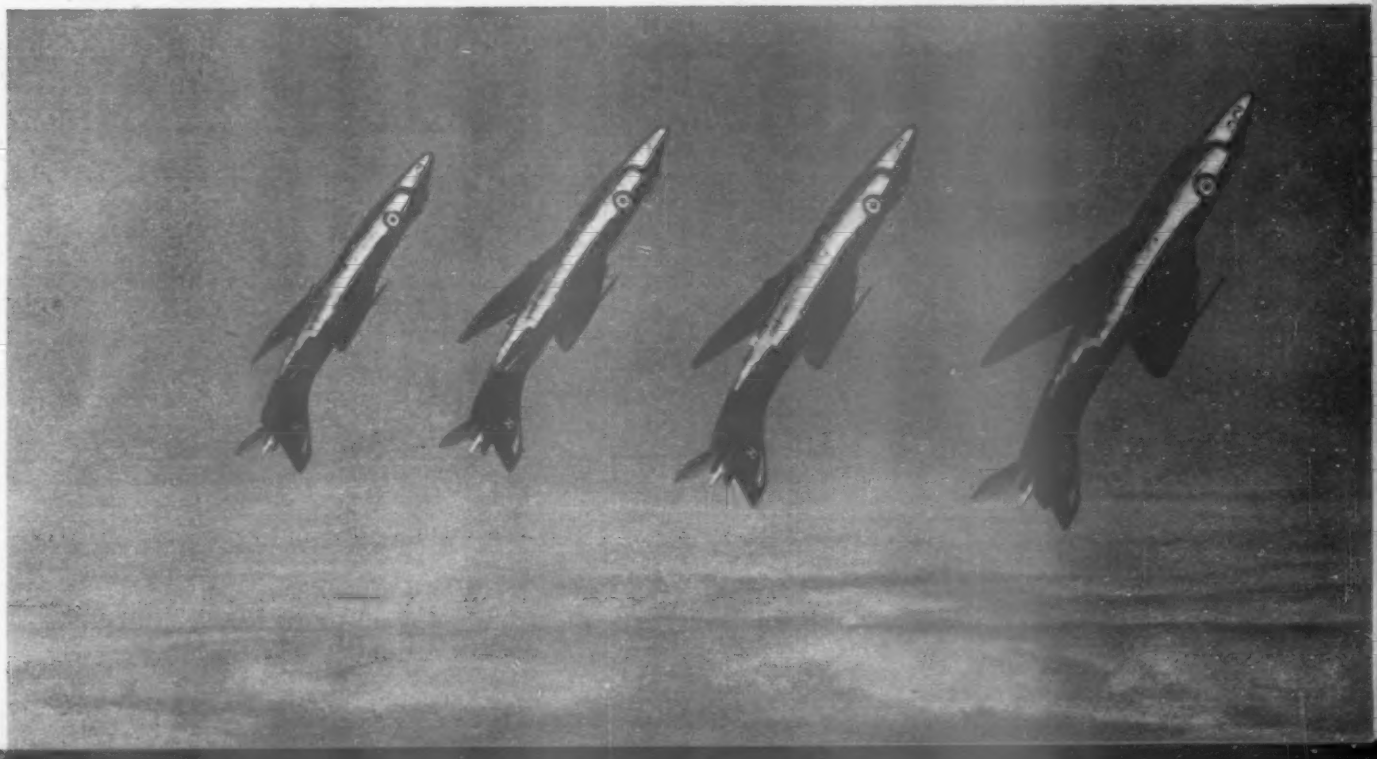
P. Twiss and D. J. Whitehead.

Farnborough First Report . . .

Once again, the Royal Navy and Royal Air Force are delighting the crowds at Farnborough this week with their daily displays of impeccable formation aerobatics. We present here a selection of views of No. 807 Squadron's naval Scimitars, and the Hunter 6s of No. 111 Squadron—better known internationally as the "Black Arrows"—which are representing their respective Services. The photographs, which are copyright "The Aeroplane and Astronautics," were secured from Hunter T.7s or T.8s, by A. E. Long, and are appropriately introduced on this page by the Scimitars of the Senior Service.



Service Formations at Farnborough



TWO different Service philosophies are represented by the aerobatic teams taking part in this year's S.B.A.C. Display, although the end-product, of spectacle, is remarkably similar in each case. No. 807 Squadron, R.N., which has not long had its Scimitars, is not a special display unit, whereas No. 111 Squadron, R.A.F., has specialised in formation aerobatics at air displays at home and abroad for the past 3½ years.

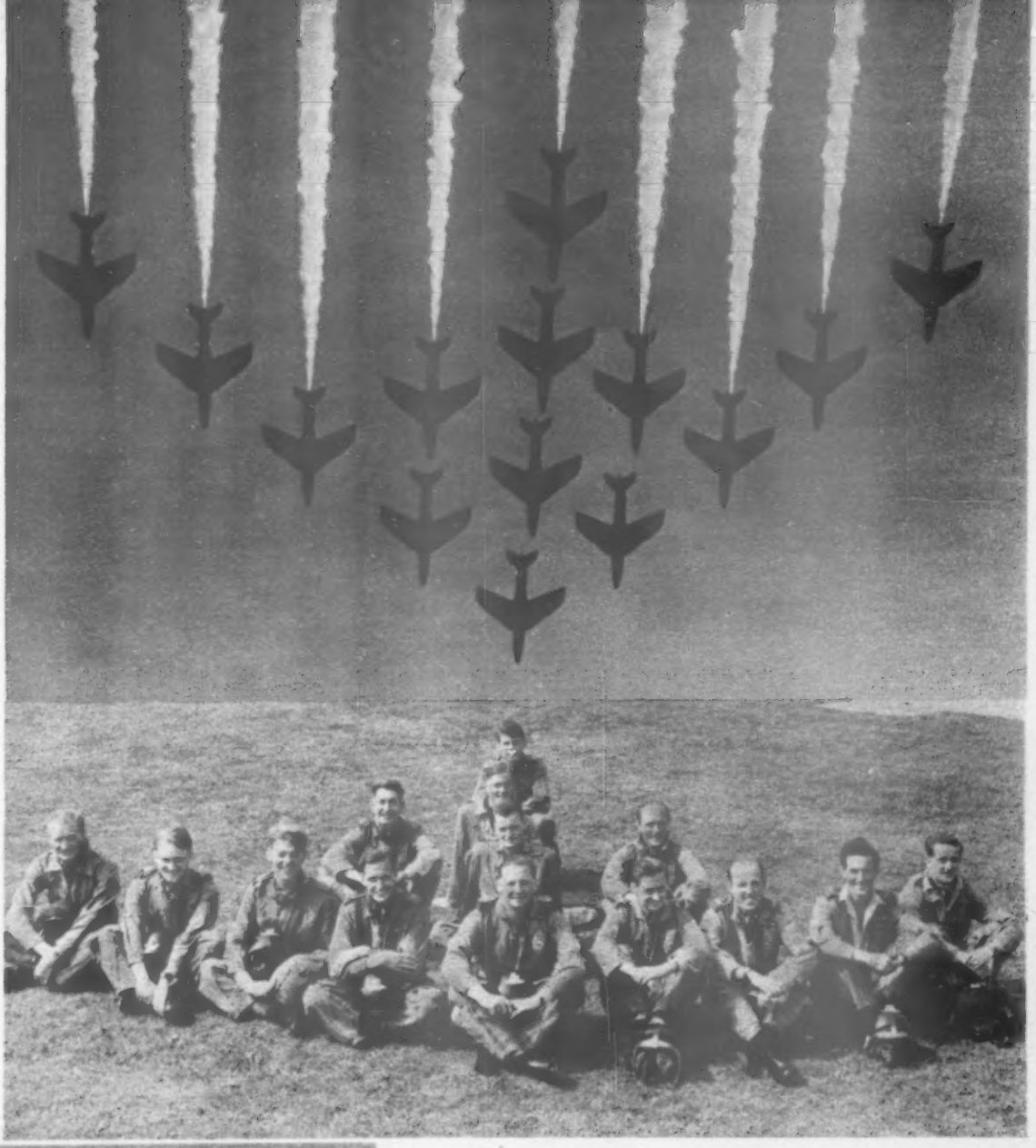
As No. 807 Squadron, led by Lieut. Cdr. K. A. Leppard, is a normal operational unit engaged in working up for embarkation in H.M.S. "Ark Royal" early next year, its display includes high-speed formation aerobatics, individual aerobatic shows, squadron take-off and landing drill, and the snatch pick-up of a dart target. The individual displays will be by Lieut. Cdr. T. C. S. Leece, senior pilot of the Squadron.

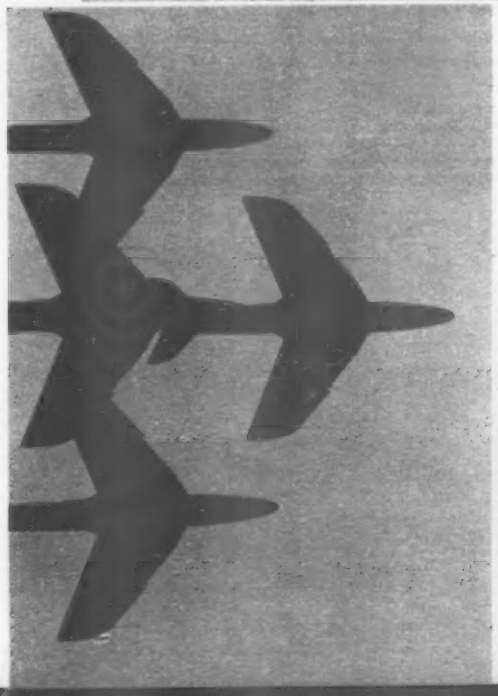
There are also considerable differences between the types of aircraft in the Naval and

Above, the black saw-tooth-winged Hunter 6s of No. 111 Squadron show their shapely plan views in the "Big Nine" formation. The rear aircraft (and one in front) are trailing smoke resulting from Diesel oil injection into their jet exhausts. Left, climbing vertically in an immaculate "wine-glass" formation.

Service Formations at Farnborough . . .

Right, fourteen Hunter 6s of "Treble One" maintain precise positioning in the "arrowhead" formation. With their banners of smoke, they make a beautiful picture, beneath which their pilots model a similar formation, with Sqn. Ldr. Peter Latham in the centre. Below, five Hunters move as one in "cross" formation.



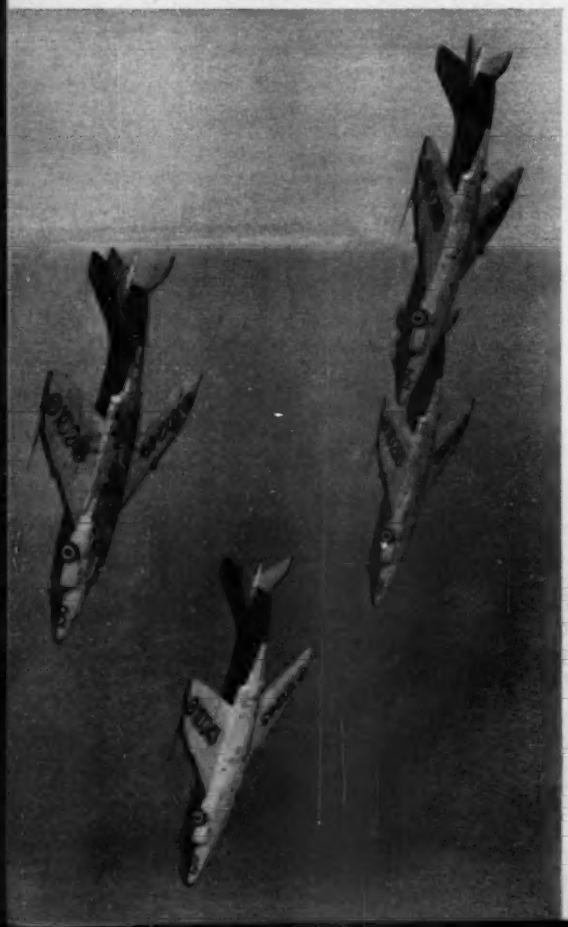


R.A.F. formation shows. The Scimitar strike-fighter is the first Fleet Air Arm aircraft with the ability to carry nuclear weapons, and with two Rolls-Royce Avon turbojets instead of the Hunter's one, is almost twice the weight of the R.A.F. fighter/ground-attack machine. Much of the training of the two Naval Scimitar squadrons has been concerned with the problems of high-speed low-level navigation to the target, and the perfection of the "loft" system used for the dropping of nuclear weapons.

Because of its much higher wing loading, the Scimitar is naturally less manœuvrable than the Hunter, so that the aerobatics of the Naval team tend to require larger areas of sky. The Scimitar's reputation for delightful handling, however, is reflected in the compact formation maintained by the four aircraft in the aerobatic team.

As the official display squadron of the R.A.F., "Treble One" have brought their performance, under Sqn. Ldr. Peter Latham, who took over from Sqn. Ldr. Roger Topp, to an amazing degree of precision. All fourteen aircraft in the squadron now take part in the initial part of its display, which then progresses to allow two teams, of nine and five Hunters, to provide a non-stop performance of formation changes,

Service Formations at Farnborough . . .



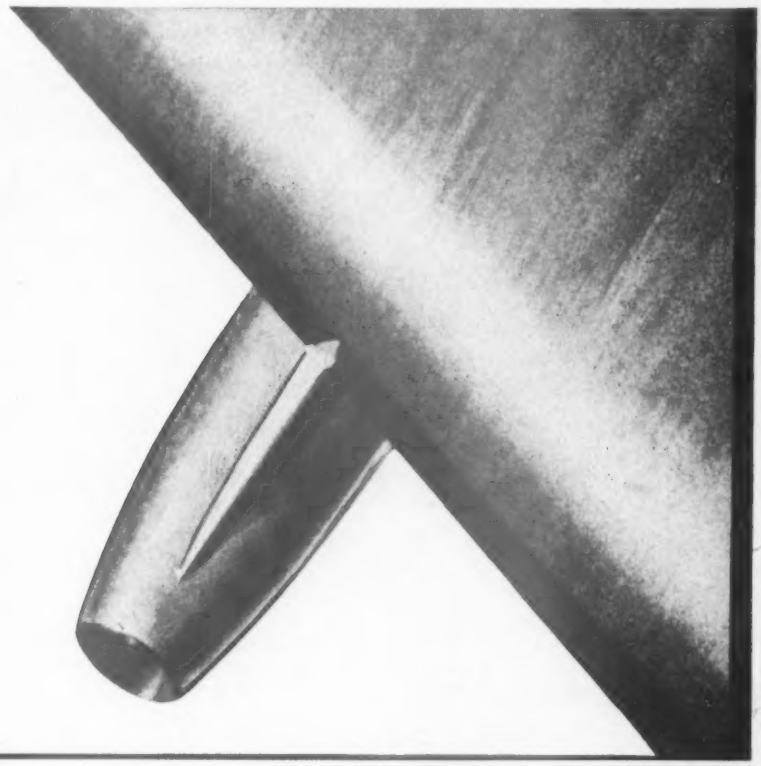
painted with effective use of white smoke against the blue back-drop of the sky.

"Treble One's" international predominance in the field of team aerobatics has been tacitly acknowledged by the adoption of many of their novel formations—"half-swan," "card-five," "fork" and so on—by other national aerobatic teams. Some of these are extremely good, but none so far has the polish, positioning and precision achieved by No. 111 Sqn.

In the Hunter 6, of course, the R.A.F. have an almost ideal vehicle for this type of flying. Beautiful to fly, with a tractable turbojet engine providing a useful margin of power, the Hunter is made even more manœuvrable by the use of 15 degrees of flap throughout the performance. A final commentary on the value of a display squadron, apart from considerations of international prestige, is provided by the fact that "Treble One" maintains its normal routine training to the point where above-average scores are achieved by nearly all its pilots at annual armament practice camps.

The Scimitar team is led by the C.O. of No. 807 Squadron, Lieut. Cdr. K. A. Leppard, who is seen at the head of his pilots in their ground "formation". The single Scimitar is shown in an operational rôle with its external load of bombs and drop tanks in position, and Blackburn Palouste gas-turbine starter plugged in.

PRECISE finger on the pulse



Ultra-sensitive pickup senses vibration at selected frequencies. Only 2.6 inches high, weighs 0.47 lb. Withstands temperatures from −65° to +500° F.

Sperry's Turbine Vibration Indicating System for top performance of turbo-jets and turbo-props

One leading airline after another is ordering the new Sperry Turbine Vibration Indicating System for their new jet-powered transports. With good reason, too—this electronic system contributes to more efficient turbine performance by monitoring engine mechanical condition for peak performance.

REPORTS CONTINUOUSLY

Heart of the Sperry system is a rugged but extremely sensitive pickup installed in the powerplant at several locations. If vibration in any turbine or propeller approaches prescribed limits, the pickup instantly reports this through an amplifier to a cockpit indicator. The pilot then takes corrective action, if required, by reducing power or shutting down the affected engine.

EASILY INSTALLED, MAINTAINED

Beside contributing to passenger comfort, and reducing chance of turbine damage due to vibration, the Sperry system is quickly installed and easily maintained. Compact in size all parts are built to withstand severe mechanical stresses and temperature changes. In addition, there's no need for recalibration of the pickup or the system when a component is replaced.
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Propulsion through the ages...

A Great Pioneer—Sir George Cayley, 1843.

This dramatic but imaginary scene shows how the fruition of a dream might have appeared. This strange machine was designed for vertical take-off and landing, after which the four rotors were adjusted for forward flight, propulsion being provided by two pusher-propellers. The inventive genius who saw this vision of the future was a Yorkshireman, Sir George Cayley, who also designed internal combustion engines worked by gunpowder—and constructed the model kite-glider seen in the hands of the spectator on the right. Cayley was the first man to realise the aerodynamic potentialities of the kite, and the model here about to soar over the peaceful Wolds was the first successful heavier-than-air craft to be built.

Sir George Cayley was a pioneer; and so too is Rotol; for they designed, developed and produced the propellers for the first turbo-prop aircraft to fly. To-day, over 100 airline and aircraft operators across the world attest to the reliability of Rotol propellers—standard equipment on the Vickers Viscount; Fairchild F.27; Grumman Gulfstream; Armstrong Whitworth Argosy; the Fairey Rotodyne, and many other aircraft.

THE FAIREY ROTODYNE

Rotol are proud to have an important share in the development of this revolutionary aircraft—the world's first vertical take-off airliner. The two Napier Eland engines drive two Rotol four-bladed "forward flight" propellers—and Rotol also provide two gear-boxes for each engine; a constant speed unit, and a throttle governor.

ROTOL

A member of the Dowty Group

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Pilots Taking Part . . . .

(*Continued from page 196*)

R.N. Helicopter Squadron, 1945. Joined Westland Aircraft as senior helicopter test pilot, 1949. Joined Saunders-Roe in 1952; became chief test pilot in 1958.—**P.531.**

H. C. Rogers, D.F.C. and Bar—Assistant chief test pilot, Rolls-Royce, Ltd. Born, 1922. Joined R.A.F., 1938, and trained as pilot, 1941. Was chief flying instructor, Tollerton Airport, before joining Rolls-Royce in 1948. Appointed to present post, 1954.—**Conway Vulcan.**

R. N. Rumbelow.—Test pilot, Hunting Aircraft, Ltd. Born, 1930. Joined R.A.F., 1951, and was flying instructor 1955-57. Joined Hunting Aircraft, 1957.—**Jet Provost.**

W. H. Sear.—Chief test pilot, Westland Aircraft, Ltd. Born, 1923. Joined R.A.F., 1942; transferred to Fleet Air Arm, 1945. Took E.T.P.S. Course, 1951, and went to "C" Squadron, A. and A.E.E. Boscombe Down. Seconded to Westland, 1953. Was appointed chief test pilot in 1955.—**Westminster G-APLE.**

C. W. Simpson.—Test pilot, Sir W. G. Armstrong Whitworth Aircraft, Ltd. Born, 1924. Joined R.A.F., 1942, and transferred to R.N. in 1946. Technician with Bristol Aero-Engines, 1948-1950. Rejoined R.A.F., 1950, and went to Armstrong Whitworth last year from Handling Squadron at Boscombe Down.—**Argosy.**

J. W. C. Squier.—Chief production test pilot, English Electric Aviation, Ltd. Born, 1920. Test pilot in R.A.F., 1941. Joined English Electric, 1946.—**Lightning.**

E. A. Tennant.—Chief test pilot, Folland Aircraft, Ltd. Born, 1922. Qualified as R.A.F. pilot, 1941. After taking E.T.P.S. course, went to A. and A.E.E. Boscombe Down in 1950. Joined Folland, 1953.—**Gnat Trainer.**

G. F. Thornton, D.F.C.—Sales department, de Havilland Aircraft Co., Ltd. Born, 1922. Joined de Havilland from R.A.F. as production and development test pilot, 1949.—**Beaver.**

J. Towle—Production and experimental test pilot, Gloster Aircraft Co., Ltd. Born, 1927. Learned to fly in 1950 with Nottingham U.A.S. Joined R.Aux.A.F., 1954. Joined Gloster as test pilot in 1957.—**Javelin FAW.9.**

E. B. Trubshaw.—Deputy chief test pilot, Vickers-Armstrongs (Aircraft), Ltd. Born, 1924. Joined R.A.F., 1942. Pilot in King's Flight, 1946-48. Joined Vickers-Armstrongs as experimental test pilot, 1950, and appointed deputy chief test pilot in 1952.—**Vanguard.**

L. P. Twiss, O.B.E., D.S.C. and Bar.—Chief test pilot, Fairey Aviation, Ltd. Born, 1921. Joined Fleet Air Arm, 1939. Took E.T.P.S. Course, 1945, and went to Naval Test Squadron, A. and A.E.E. Boscombe Down. Joined Fairey Aviation, 1946. Holder of World Speed Record in Fairey Delta at 1,132 m.p.h., 1956-57. —**Gannet AEW.3.**

P. Varley.—Test pilot, Sir W. G. Armstrong Whitworth Aircraft, Ltd. Born, 1924. Joined R.A.F., 1941. E.T.P.S. course, 1950, followed by test-flying at Boscombe Down. Joined Gloster, 1955, as deputy chief test pilot. Joined Armstrong Whitworth, 1958.—**Argosy.**

P. M. R. Walton.—Test pilot, Sir W. G. Armstrong Whitworth Aircraft, Ltd. Born, 1923. Joined R.A.F., 1942. Birmingham University, 1948. Joined Armstrong Whitworth design staff, 1953, and has been test flying since that year.—**Argosy.**

D. J. Whitehead, A.F.C.—Chief test pilot, Blackburn Aircraft, Ltd. Born, 1925. Qualified as pilot in R.A.F., 1945, and transferred to R.N. three months later. Permanent commission in R.N., 1949. Took E.T.P.S. course, 1954, and went to Naval Test Squadron, Boscombe Down. Joined Blackburn, 1958.—**N.A.39.**

L. M. Whittington.—Test pilot, Folland Aircraft, Ltd. Born, 1923. Qualified as R.A.F. pilot, 1943. After the War was in Air/Sea Warfare Development Unit. Took E.T.P.S. course, 1950. In "B" Squadron, A. and A.E.E. Boscombe Down, 1951-53. Joined English Electric, 1953, as assistant experimental pilot. Joined Folland, 1955.—**Gnat Mk. 1.**

P. A. Wilson, A.F.R.Ae.S.—Development test pilot, de Havilland Aircraft Co., Ltd. Born, 1924. Joined R.A.F., 1942. Went to Scottish Airlines, 1948. Joined B.E.A., 1950, and B.O.A.C., 1952. Development test pilot, Hunting Clan Air Transport, 1955. Joined de Havilland, 1957.—**Comet 4B.**

G. Worral.—Chief production test pilot, Gloster Aircraft Co., Ltd. Born, 1922. Joined R.A.F., 1940. Left R.A.F., 1946, and joined Gloster as technical representative. Joined test pilot staff in 1950.—**Javelin FAW.9.**

General Aviation News

SARO CONTRACT. — Negotiations are in progress for a development contract for Saunders-Roe P.531 helicopters for the Army Air Corps.

LOCKHEED EXPANSION.—Reorientation and closer co-ordination of Lockheed's overseas effort is being organized. A "top-level" corporate office is being opened in Paris and Mr. A. B. Vosseller has been elected vice-president in charge of company activities and interests in Europe, Africa, and the Near East. He joined Lockheed in 1956 after 32 years' service with the U.S.N., from which he retired with the rank of Vice-Admiral.

BOEING REORGANIZATION.—The Seattle and Pilotless Aircraft Divisions, and the Systems Management Office, of the Boeing Airplane Co. have been merged to form an Aero-Space Division. It will be responsible for assembly, test and system integration of the Minuteman ICBM, the weapon-system management and production of the Bomarc SAM, design and construction of the B-70 bomber wing, and advanced development programmes, such as Dyna-Soar.

SHELTER-LAUNCHED. — The U.S.A.F. has successfully launched an F-100 Super Sabre from inside a steel-and-concrete atomic blast shelter. With the aid of a 130,000-lb. thrust rocket the fighter reached a speed of 275 m.p.h. in 4 sec.

LONG-RANGE TROOPER. — The first of the U.S.A.F.'s new Lockheed C-130B troop-cargo transports powered by Allison prop-jet engines has made a 4,618-statute-mile non-stop flight from Hickam A.F.B., Honolulu, to Dobbins A.F.B., Georgia.

U.K. NAVIGATION.—A $3,500,000 U.S.A.F. building programme in the U.K. includes the installation of TACAN stations at Brize Norton, Lakenheath and Bovingdon.

MARCONI CONTRACT.—A "substantial order" for Marconi AD 2300 Doppler equipment and navigation computers for the Mirage 4 has been given to Marconi's Wireless Telegraph Co., Ltd., by Générale Aéronautique Marcel Dassault.

HERALD HOME.—The Handley Page Dart Herald returned to Blackbushe on August 27 at the end of its 32,000-mile tour of South America and the Caribbean. In the course of this tour, the Herald flew for 162 hours, visited 16 countries and carried over 1,400 passengers.

WELL DONE.—Twice the speed of sound was achieved on August 26 by Mme. Jacqueline Auriol flying a Mirage III. Mme. Auriol made the flight from the Istres test centre near Marseilles.

CANBERRA VARIANTS.—A U.S.A.F. RB-57D built by Martin's Baltimore Division for Strategic Air Command reconnaissance units. Compared with the standard B-57B bomber also shown, the P.R. version has a greater wing span, larger engine nacelles and appears to be single-seat.

NEXT WEEK

THE AEROPLANE AND ASTRONAUTICS for September 18 will be another enlarged issue and will have a further report of the S.B.A.C. Display and Exhibition. It will also contain a survey of the World's agricultural aircraft.

AIR LAW COURSES.—University College, London, has two courses on International and Comparative Air Law for non-degree students. The first-year course, starting this year on October 13, covers general principles, and the second, starting October 14, selected problems. Each course is self-contained and can be taken separately. Details from the College's Faculty Office, Gower Street, London, W.C.1.

NEW POU.—A new version of Henri Mignet's pre-War Flying Flea is flying in France. The outer wing panels can be folded inward for stowage and towing.

G.E.C. CENTURY.—Lufthansa has ordered specially designed air-circulation ovens for its Boeing 707s from G.E.C. The company is the hundredth airline or air transport organization to specify G.E.C. aircraft electrical equipment. The range includes fans, cabin lighting, reading lights, water heaters and stewards' call systems, in addition to catering equipment. G.E.C. entered this field in 1944 by supplying equipment for Sir Winston Churchill's personal York. The first airline order came from B.S.A.A. in 1946, and the first overseas order from K.L.M. in 1947. The company now supplies all B.O.A.C. and B.E.A. aircraft.

Commercial Aviation Affairs

MOSCOW AIRPORTS.—The third Moscow Airport, opened recently, is at Sheremetyevo. It supplements Vnukovo and Bykovo airports.

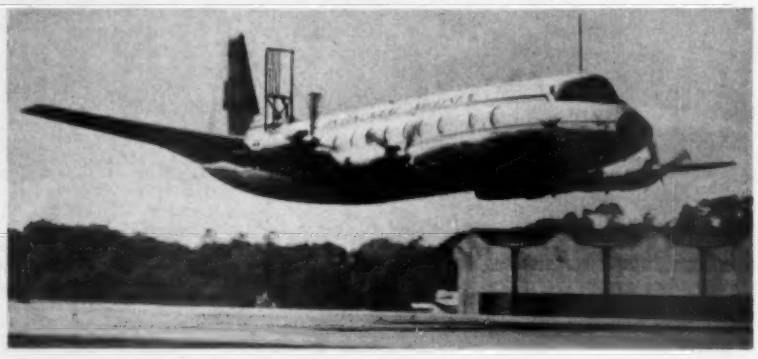
AIRPORT OPERATION.—F.A.A. is seeking to set up a National Capital Airports Corporation to undertake the management of Washington's airports—the existing National Airport and the new Dulles International Airport.

ELMDON TAKE-OVER.—Birmingham Corporation expects to take over Elmdon Airport from M.T.C.A. on January 1, and to assume full responsibility on April 1. M.T.C.A. will continue to contribute 60% to capital development expenses and provide ATC and other essential services.

KANGAROO JETS.—Qantas will put its Boeing 707-138s on to the Sydney-London Kangaroo route on October 15, and B.O.A.C. will start using Comets on the route on November 4. Qantas will fly three services a week and B.O.A.C., five a week; there will also be a weekly Qantas Constellation service from Sydney via Melbourne, Perth and Djakarta to Singapore, connecting with a Comet service there. On November 3, Qantas will introduce an all-freight Sydney-London service using an L-1049.

ALL CLEAR FOR PRESTWICK.—On September 3 the Ayr County Council accepted the latest proposals for making an immediate start on the development and extension of the main Prestwick runway for use by the long-haul turbo-jet transports next summer. Discussions on the method of dealing with the A.77 road traffic have been deferred and the present control system will continue. A new terminal building, adjoining the railway and on the south side of the extended runway, is to be built.

ARGENTINIAN LOSS.—One of the three Comet 4s so far delivered to Aerolineas Argentinas crashed while on the approach to Asuncion Airport, Paraguay, on August 27 in poor visibility. On a flight from Buenos Aires to New York the Comet apparently flew into the ground about eight miles from the airport. The captain was killed and one of the 58 passengers died.



HYBRID TEST VEHICLE. — Vickers-Armstrongs' own Viscount 810 prototype (still in Continental markings) has for some time been used for Vanguard development work—first with the control system and later with a tail-plane section in place of the standard Viscount fin. This is fitted with a Napier Spraymat de-icing system and a water-spray rig has been mounted on the rear fuselage of the 810.

News About People

COACHMAKERS' OFFICERS.—At a recent meeting of the Court of the Worshipful Company of Coachmakers and Coach Harness Makers the following officers were elected for the ensuing year:—Master: The Hon. D. G. Berry, T.D.; Senior Warden: Sir Reginald Verdon Smith; Renter Warden: Col. G. A. Norris, O.B.E., M.I.Mech.E.; and Junior Warden: Mr. P. S. Croall.

SPERRY EXECUTIVE CHANGES.—From the Sperry Gyroscope Co., Ltd., comes news that Mr. R. Broadbent, the company's managing director, has been appointed chairman to succeed Mr. A. Hillier, O.B.E., who retired at the end of July. He has also been appointed chairman and managing director of the subsidiary company, New Holland Machine Co., Ltd., and chairman of Industrial Products (Speco) Ltd. Mr. G. E. D. Whitaker has become a director of the New Holland Machine Co. and remains as general manager. Mr. S. E. Spicer, a director of Sperry Gyroscope, has been appointed to the board of Industrial Products (Speco) Ltd.

MINISTRY APPOINTMENTS. — Among recent changes at Under Secretary level in the M.T.C.A. is the appointment of Mr. R. R. Goodison to take charge of the Aviation Safety and General Group in place of Mr. C. W. Evans, who is retiring. Mr. G. S. Riddle has been appointed private secretary to Mr. John Hay, M.P.

NEW PRESIDENT.—Mr. L. A. Woodhead, managing director of Cossor Instruments, Ltd., has been elected president of the Scientific Instrument Manufacturers' Association. Other new officers of the Association are: Mr. A. W. Rundle of A. Gallenkamp and Co., Ltd., Hon. Treasurer; and Mr. E. R. Ponsford of Solartron Electronic Group, Ltd., Hon. Secretary.

AERO GOLF.—The Aero Golfing Society held a meeting at Woodcote Park at the invitation of Mr. F. A. Laker on August 28. The morning nine-hole medal competition was won by D. H. Steel. The afternoon two-ball Stapleford competition was won by R. E. Hardingham and L. H. N. Bickmore. Runners-up were S. W. C. Taylor and H. K. Cartwright.

Anywhere in the World is an Airfield...

Anywhere, that is, where there's a 100 yards or so of anything like level ground, the Twin Pioneer lands comfortably on that, and takes off from even less. Simply, cheaply — almost sedately — the Twin Pioneer is opening up some of the most difficult territories in the World.

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WINGS DAY SEPT. 19th

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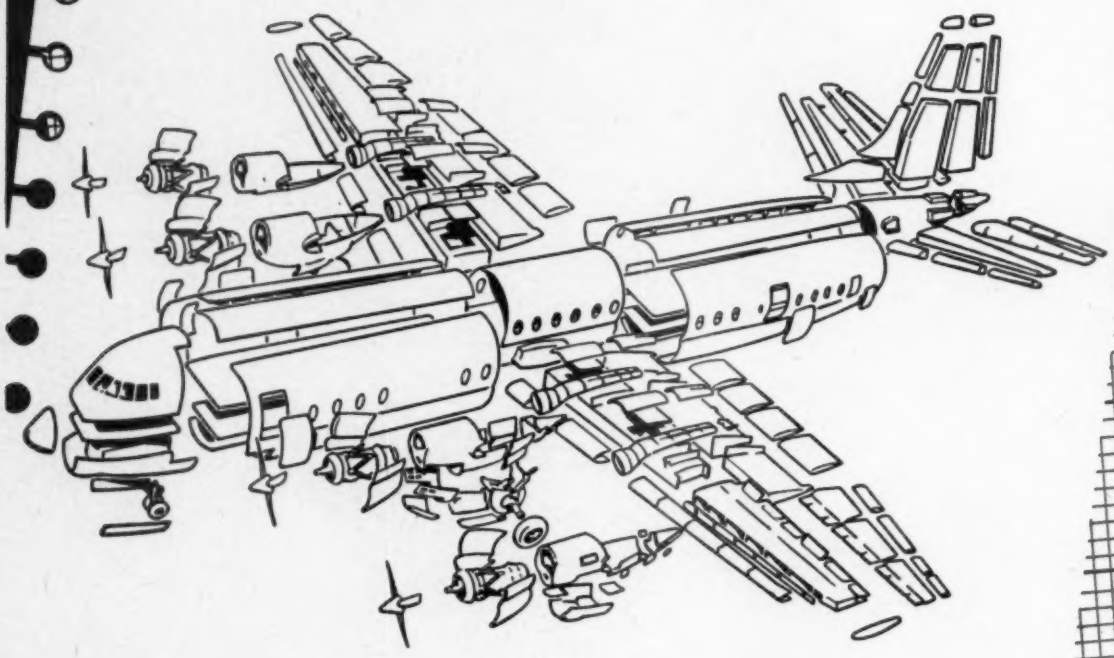
16 PASSENGER

Twin Pioneer

NOW FITTED WITH HIGHER-POWERED ALVIS LEONIDES OR PRATT & WHITNEY R. 1340 ENGINES.

VANGUARD STRUCTURAL DRAWING



... and when it came
to Batteries
the choice was
DAGENITE

See them on Stand 257 S.B.A.C.

PETO AND RADFORD · 137 VICTORIA STREET · LONDON · SW1

PR30

Correspondence

Grahame-White's Gold Medal

IN his interesting article on the career of my old air friend Claude Grahame-White, whose death came as a big shock to me, "G.D." says that though Claude did so much to further British aviation, he received no medals, decorations or honours in Britain.

This is not strictly accurate, as in 1910 he received the Gold Medal of the Royal Aero Club to commemorate his victory in the Gordon Bennett race of that same year.

Epsom, Surrey. HARRY HARPER.

Saving One Sunderland

PETER THOMAS deserves support from all past Sunderland pilots and crews in his plea that one boat should be kept by the R.A.F. for display and inspection. If a central base like Calshot is not available, then Pembroke Dock is the obvious place.

Despite the many added duties, and frustrations, of a flying-boat crew all had great pride in their boats, which were often "home" for quite long periods. What pleasure we would all have in seeing a Sunderland again, whether in the air or up on a slip. With this feeling of comradeship amongst old boat crews the more's the pity that the ex-boat squadrons in this country never hold re-unions (except, I believe, 202). My two wartime squadrons have only managed one between them—in 1946! For goodness sake try and keep the boat tradition alive.

Kirtlebridge, Dumfriesshire. HECTOR MONRO.

Increase in Business Flying

ON page 74 of the issue of THE AEROPLANE AND ASTRONAUTICS for August 28 last, it is suggested in the article "Personal Flying" that an organization should be set up to advise business pilots on all matters concerning business flying.

The Royal Aero Club already provides for its members an advisory service on all aspects of private and business flying and it is heartening to know that a distinct upward trend is noticeable in the interest shown by firms and individuals in this form of aviation, the trend reflected in the increasing use made by members in recent months of the facilities offered by the Club in this direction.

London, W.1. J. H. BLAKE,
Public Relations Officer—R.Ae.C.

A Curtiss Prop?

I HAVE found, some time ago, a broken prop from an engine of about Great War vintage.

I would like to trace, if possible, details of this engine and possibly the aircraft to which it was fitted. As the aircraft may be of American origin this may be difficult.

The markings on the prop boss are as follows:—

One side:
AD 543 R.H
90 HP CURTISS
G 314 N 95
and the other:
D 2520
P 1580
G 31(?) N 95

Farnborough, Hants. K. R. F. KENWORTHY.

Nine Days' Hard

IT must have been one of those rare clockwork ferrying days when (see the letter in the issue of August 21) Messrs. Warren and Burstow completed their six delivery-cum-taxi flights in six different aircraft types. During that era of self-navigation, often in strange and harassing devices, records of the opposite kind were more usual.

One ferry pilot, to my knowledge, spent nine days early in 1940 taking a Wellington 1 from Marham, Norfolk, to Aldergrove, Northern Ireland. Drip-dry shirts had not then been invented and over-night bags were kept small enough to go into odd crannies like gun bays. So it was a far from jolly trip, with damp stops at Squires Gate and West Freugh, and intermediate prowlings around St. Bees Head, where the clouds were always down on the sea.

Characteristically enough, after eight days of fog and/or low cloud, the ninth day was cloudless. When the Wellington had been delivered the pilot was motored over to Belfast Lough, whence he took a Hereford (and his ear defenders) some 250 miles straight down to the Cotswolds. An inversion produced ground mist all over the North Midlands, but he navigated successfully by the then familiar and remarkably reliable balloon-barrage-plotting method.

Nevertheless, even this pilot has to admit that there were some good ferrying days when everything went according to plan. A few weeks before the Wellington trip he had flown, in one winter's day, a taxi Anson from Bristol to Kemble and Brockworth; a Gladiator to Shawbury; an Anson to Liverpool; a Blenheim to Hullavington; and an Anson to Croydon, via Aston Down, Kemble and Brize Norton. His logbook does not explain why he went to Croydon; logbooks can be as extraordinarily unevocative as they are sometimes evocative.

London, S.W.3. H. A. TAYLOR.

Saab Lansen

WHILST reading the Paris Air Show Report in THE AEROPLANE AND ASTRONAUTICS (August 14, 1959), I found a mistake in the designation of the Saab Lansen which appears on page 8, Military Aircraft at the Salon. I quote, "Saab also displayed its 35B Lansen two-seat all-weather fighter." The correct designation is the Saab 32B Lansen. I hope this mistake will be rectified.

Maidstone, Kent. G. W. SHAW (MASTER).

[Thank you. It will be.—ED.]

Groundabout

The Farnborough Flavour

"He's a real salesman. He's sold his wife the idea that Farnborough runs a fortnight."—*D.H. Gazette.*

*

Then there's the wife of a newcomer to the industry: "Well, I think there's something pretty fishy about an air display where they show pods and plants."

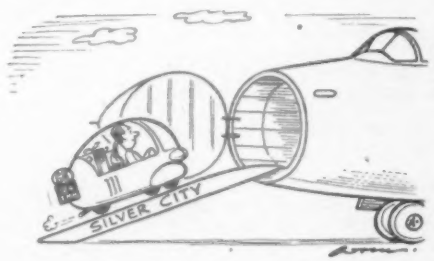
*

Probably the same lady who asked: "Does that mean that there are 807 squadrons in the Fleet Air Arm, dear?"

A stirring thought, especially if you apply the principle to the U.S.A.F. Their VC-137A (military Boeing 707, not a Vickers job) which brought Mr. Eisenhower here, is one of three operated by the *1,298th* Air Transport Sqn. of the *1,254th* Air Transport Group. Which would mean, if my slide-rule is correct, that the U.S.A.F. have got 1,627,692 Air Transport Squadrons which, I think, verges on the moot.

*

When a friendly reader saw the Canberra with the swinging nose, it struck him that Silver City might now combine their Canberra-ferrying with some swift, if slightly expensive, Channel car ferrying.



*

Devoted followers of this column must have come away from the Hawker Siddeley stand with mixed feelings. Having heard that old Wren could be seen there in attendance on Armstrong Whitworth's vilely-named Seaslug missile, they would have found *two* Wrens, both of them *much* prettier than this one.

*

Great relief to note that the S.B.A.C., unlike its French equivalent, the U.S.I.A., still puts up a show of watching the flying and positions the company enclosures accordingly. At Le Bourget this year, half of them faced *away* from the flying. Practical people, the French.

by Warren

NOTES AND EVENTS

INSTRUMENT CALIBRATION.—A portable self-contained pitôt/static test set produced by Louis Newmark, Ltd., for use in the calibration and adjustment of aircraft instruments and autopilots. It can simulate all altitudes up to 72,000 ft. and airspeeds up to 660 knots at sea level.

HERALD STYLING.—Charles Butler Associates Design for Industry, Ltd., announces that the company has been retained by Handley Page as design consultants for the interior styling and lay-out of the standard production version of the Herald. The object of the appointment is to achieve a standard form and lay-out for the Herald which, with colour variations chosen by operators, will thus give the effect of modern custom styling.

SMITHS MOVE.—The executive management, the technical sales and services, and the accounts and commercial departments of Smiths Aviation Division now have their headquarters in Wembley. The address is Kelvin House, Wembley Park Drive, Wembley, Middlesex. Phone, Wembley 8888.

PYE SUCCESS.—An order for three sets of Pye ILS equipment has been placed by Yugoslavia, together with a considerable quantity of VHF and HF units for ground-to-air communications and a fixed station and mobile radiotelephones for airfield vehicle control.

PLASTICELL SALES.—B.T.R. Industries, Ltd., has acquired from Kleber-Colombes of Paris, the manufacturing rights in the United Kingdom of the product known in France as Klegecell, and in this country as Plasticell. Microcell, Ltd., a member of the B.T.R. Group, will now market Plasticell throughout the U.K., and the promotion and sales of the product to users in the glass reinforced plastics industry will be handled through Glass Yarns and Deeside Fabrics, Ltd., a Microcell associated company.

SERVICE TRANSPORT.—The M.o.S. has placed contracts with Leyland Motors, Ltd., for 86 special 6-wheeled chassis which are to form the basis of new refuelling vehicles and tipping trucks for the R.A.F. Based on Leyland Hippo models, powered by 125 h.p. diesel engines with four of the six wheels driven, 68 of the chassis will be used for dual purpose refuellers and 18 will be fitted with tipping gear and bodywork.

COMPANY MOVE.—After more than 25 years at Ingate Place, London, Stream-Line Filters, Ltd., has moved to new premises at Henley Park, Guildford, the headquarters of the parent company, Vokes, Ltd. The company's new address is Henley Park, Normandy, nr. Guildford, Surrey.

AIRCRAFT TYRES.—The latest addition to the Dunlop Film Library at Wilton Crescent, London, S.W.19, is entitled "Wheels on Air." Available on free loan in 16 mm. Eastmancolour and running for 11 min., the film shows the testing and inspection of Dunlop aircraft tyres, wheels and brakes before they leave the company's factory at Coventry.

NEW ACCELEROMETER.—Technical Ceramics, Ltd., has developed a new accelerometer, Type G88, weighing only 20 gm., to meet the demand for a lightweight high sensitivity transducer capable of measuring shock and vibration in guided missiles and aircraft. The piezo-electric ceramic material used has a temperature range from −40° to +80° C., low temperature coefficient and long term stability. The transducer has a linear output over the acceleration range .01 to 250g.

AVIATION CALENDAR

September 11-13.—Rally at **Baden Baden** organized by the German Aero Club.

September 13. — Newcastle-upon-Tyne Aero Club "At Home" and air race, **Woolsington.**

September 14. — Brancker Memorial Lecture, "World Peace Through Air Transportation," by Capt. E. V. Rickenbacker (Eastern Airlines) at the Royal Inst. of British Architects, 66 Portland Place, **London,** W.1, at 17.45 hrs.

September 14-20. — Battle of Britain Week.

September 15-18.—International Agricultural Aviation Conference at College of Aeronautics, **Cranfield,** Beds.

September 19.—International balloon competition at **Zurich.**

September 19.—R.A.F. "At Home" Day.

September 19.—Aviation Forum's Airborne dinner. Rendezvous at **Blackbushe Airport** 18.15 hrs.; take-off 19.00 hrs. 42s. per head. Book, John Elliott, Hon. Treasurer, Aviation Forum, 14 Tudor Court, Gunnersbury Ave., W.5.

September 20.—"Battle of Britain" Sunday.

September 23.—R.Ae.S. Graduates' and Students' Section Film Show at the Library, 4 Hamilton Place, **London,** W.1, at 19.30 hrs.

September 24.—University of London extra-mural studies lecture, "Weather Charts, Fronts," by C. E. Wallington, M.Sc. at the Kronfeld Club, Basement, 74 Eccleston Square, **London,** S.W.1.

September 24-25.—Aerodrome Owners Assn. Conference, Royal Hotel, **Bristol.**

September 26-27.—Rally organized by the Genoa Aero Club, **Italy.**

September 29.—R.Ae.S. Luton Branch lecture, "Ballistic Missile Design," by E. C. Cornford (joint lecture with E.E.C.), English Electric, **Stevenage,** at 18.30 hrs.

Company Notices

New Patents

APPLICATIONS ACCEPTED

821,411.—Hoover, V. A.—"Linear actuators."—Jan. 31, 1956

821,468.—Pacific Scientific Aeroproducts.—"Control line regulator."—Jan. 25, 1957. (Jan. 30, 1956.)

821,544.—Rolls-Royce, Ltd.—"Supersonic speed aircraft."—Aug. 24, 1956. (Sept. 8, 1955.)

821,268.—Voigt, C. A., and Devantier, K. E.—"Aircraft provided with emergency signalling devices."—Feb. 15, 1957. (Feb. 17, 1956, and Dec. 17, 1956.)

821,445.—National Research Development Corporation.—"Explosively operated quickly releasable holding devices."—July 3, 1957. (July 3, 1956.)

Printed specifications of above available Oct. 7, 1959. Opposition period expires Jan. 7, 1960.

RECEIVERSHIPS (APPOINTMENT OR RELEASE)

C. A. Swales (Aircraft), Ltd. (582,802).—Aircraft component manufacturers, etc., Half Moon Hill, Dunstable, Beds. David G. Tate, of 13 St. Peters Street, St. Albans, was appointed Receiver on April 28, 1959, under powers contained in instrument dated July 24, 1957.

INCREASE OF CAPITAL

Sywell Aerodrome, Ltd. (272,168).—8 Drapery Buildings, Northampton. Increased by £15,000 in £1 ord. shs. beyond the reg. cap. of £35,000.

NEW COMPANIES

K.D.G. Industries, Ltd. (630,766).—Private co. Reg. June 19. Cap. £1,000 in 20,000 shs. of 1s. Manufacturers of and dealers in instruments, gauges, fuel and oil piping, indicators, controllers, recorders and other accessories. Directors: R. B. Ogden, F.C.A., E. W. T. Stow, A.M.I.Mech.E., etc. W. A. Pugsley, A.C.W.A., F. E. Barritt, B.Sc., and L. R. Pullen. Solrs.: Theodore Goddard and Co., 5 New Court, W.C.2.

Macal Equipment Co., Ltd. (629,356).—Private co. Reg. June 2. Cap. £2,000 in £1 shs. Objects: To carry on the business of general, precision, mechanical, motor, aeronautical, electrical and constructional engineers; manufacturers of and dealers in thermo-plastics and thermo-setting plastics, etc. Directors are: Richard E. McCarthy, 26 Vale Close, Lower Bourne, Farnham, Surrey; and Albert Hale, 8 Salcombe Drive, Morden, Surrey. Sec.: Kathleen M. Swift. Reg. office: 63 Effra Road, Brixton, S.W.2.

Skimcraft, Ltd. (631,992).—Private co. Reg. July 6. Cap. £100 in £1 shs. Manufacturers of and dealers in all kinds of hovercraft, cushion craft, surface skimming craft, etc. Directors: Elsa Bennett and Donald C. T. Bennett, both of Deepwood, Farnham Royal, Bucks. Directors of Air Britannica, Ltd., etc. Sec.: Elsa Bennett. Reg. Off.: Deepwood, Farnham Royal, Bucks.

Vigors Aviation, Ltd. (630,896).—Private co. Reg. June 23. Cap. £1,000 in £1 shs. To purchase, sell, import, export, build, hire, charter or otherwise acquire, hold or dispose of aircraft, helicopters, etc. Subscribers (each with one sh.): R. H. Dixon, solicitor, and A. G. Staplehurst, solicitor's clerk, both of 4 Throgmorton Avenue, E.C.2. First directors to be appointed by subscribers. Solrs.: Travers Smith, Braithwaite and Co., 4 Throgmorton Avenue, E.C.2.

Personal Notices

BIRTHS

Hughes.—On August 24, at Bushey Heath Maternity Home, to Norma, (*née* Phillips), wife of Wg. Cdr. D. L. Hughes, R.A.F.—a daughter.

Mallorie.—On August 27, at R.A.F. Nocton Hall, Lincoln, to Ursula, wife of Wg. Cdr. P. R. Mallorie, R.A.F.—a son.

Rayson.—On August 23, at Montreal, to Rosemary (*née* Wardley), wife of Flt. Lt. M. J. Rayson, R.A.F.—a daughter (Karen Leigh).

Scott.—On August 26, at the Louise Margaret Hospital, Aldershot, to Barbara (*née* Guest), wife of Sqn. Ldr. P. H. L. Scott—a daughter (Jane).

Scrivens.—On August 28, at R.A.F. Hospital, Wroughton, to Meirwen, wife of Flt. Lt. E. R. Scrivens—a son.

Stokes.—On August 26, at Leamington Spa, to Mary (*née* Thompson), wife of Flt. Lt. F. Stokes—a daughter (Judith Gaye).

Torrens.—On August 27, at Greenwood, Nova Scotia, to Barbara Beda (*née* Cheel), wife of Flg. Off. P. A. Torrens, R.C.A.F.—a son (Philip).

Wood.—On August 23, at the Grantully Nursing Home, West Hartlepool, to June (*née* Campany), wife of Sqn. Ldr. C. J. S. Wood—a son.

DEATHS

Fairbairn.—On August 29, at Melbourne, Australia, Gp. Capt. Charles Osborne Fairbairn, O.B.E., A.F.C., of Banongill, Skipton, Victoria.

Hardaker.—On August 26, Flt. Lt. John Hillary Hardaker, R.A.F., Central Flying School.

Tew.—On August 26, at Cannes, Sqn. Ldr. W. H. E. Tew, R.A.F. (Retd.).

This is the Murphy MR 380 Aircraft Tape Reproducer specified by BOAC for use in their Boeing 707

The Murphy MR 380 is an aircraft unit designed to play standard 2 track ¼-in. pre-recorded tapes over the aircraft Passenger Announcement System. It has been specified by BOAC for their Boeing 707 aircraft to be delivered later this year. Here are the brief facts:

Frequency Response:	Level from 50—7000 c/s NARTB equalised.
Pre-Amplifier:	Plug-in, transistorised unit, removable for servicing.
Tape Transport:	By 28-volt governed motor giving automatic reversal at each end of tape, with manual over-ride for spool changing.
Spools:	7 in. diameter, giving 2 hours playing time at 3¾ ips.
Control:	Remote combined or independent ON-OFF switching and Gain Control. ON-OFF switch incorporates automatic fade in and fade out feature.
Size:	Standard ½ ATR long to ARINC characteristic 539.

The Murphy leaflet all about the MR 380 is yours for the asking.

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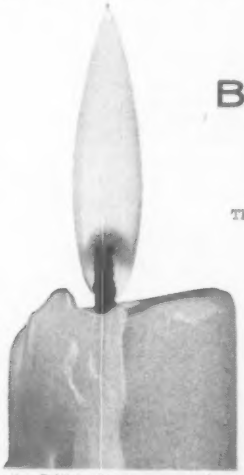
The simplicity of this B.O.A.E. system makes it very flexible. It can be adapted for aircraft, missiles, individual equipment installations—and even single flying suits, merely by varying the size of the liquid container and the flow rate. In fact if anyone has a wrist watch that runs too hot, we may be able to help.



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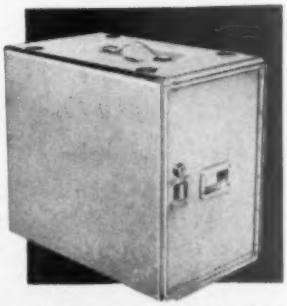

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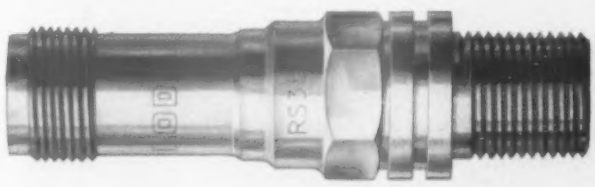

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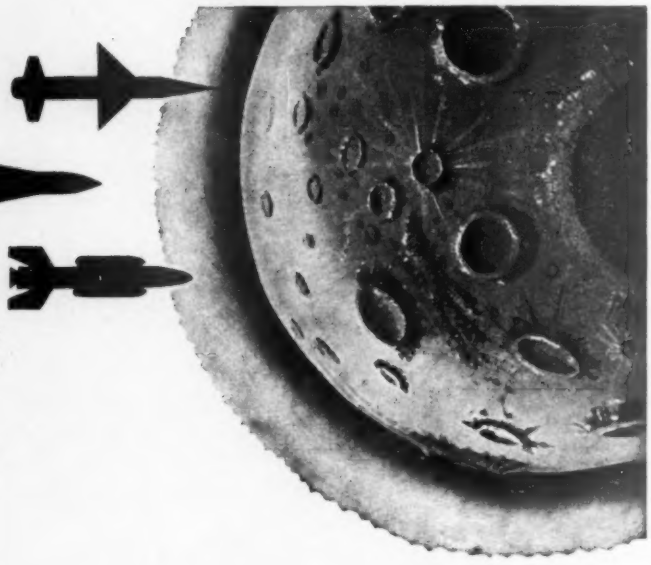

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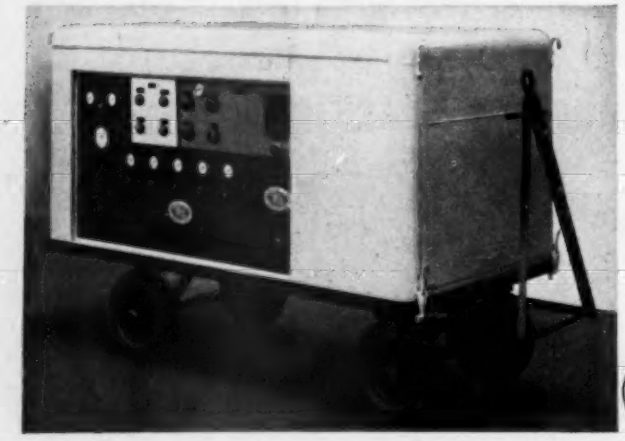

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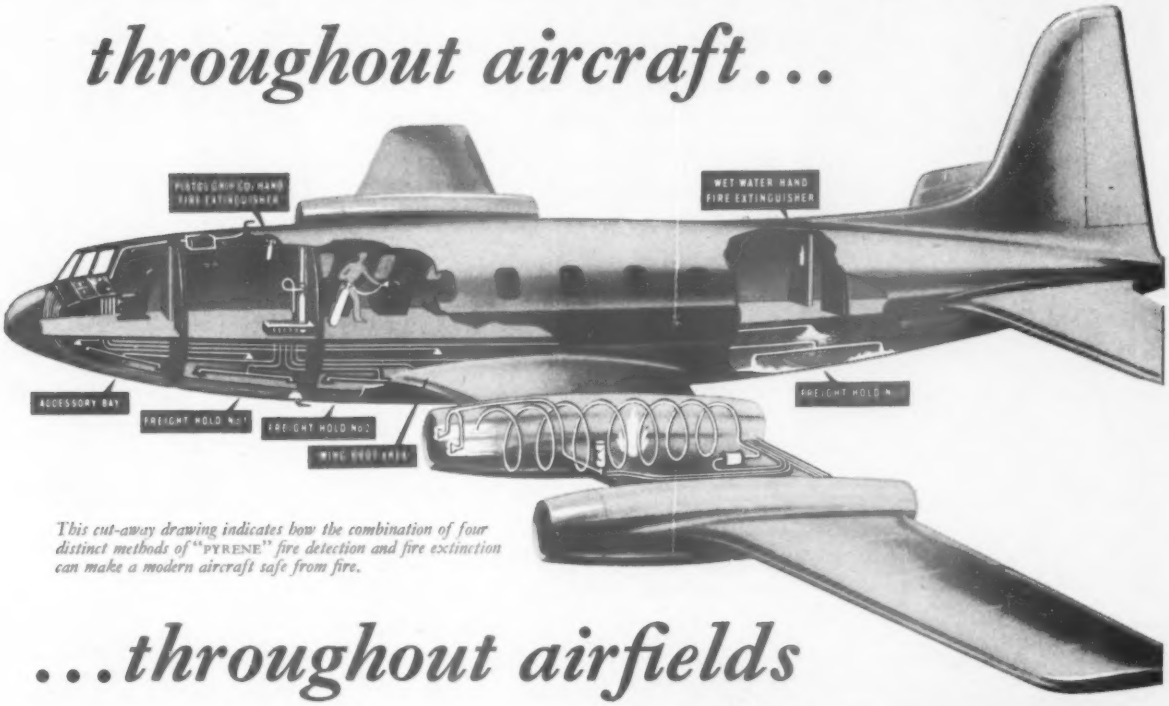

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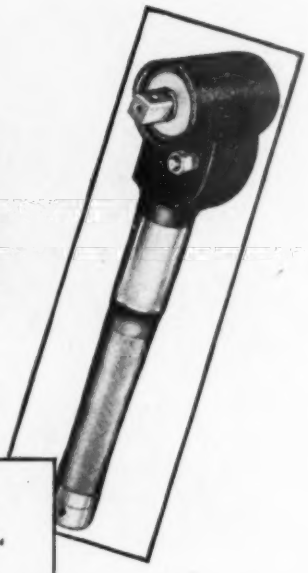

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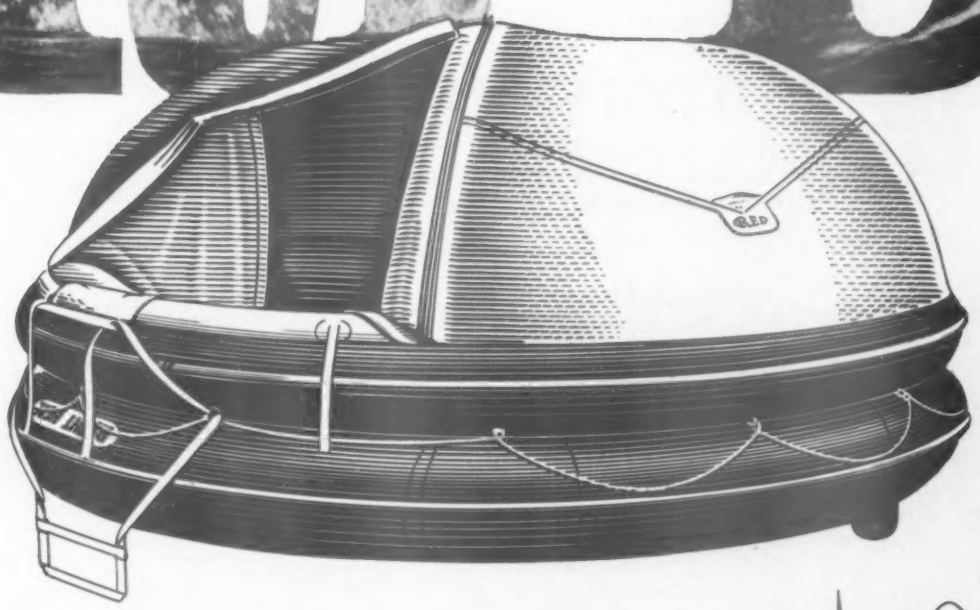

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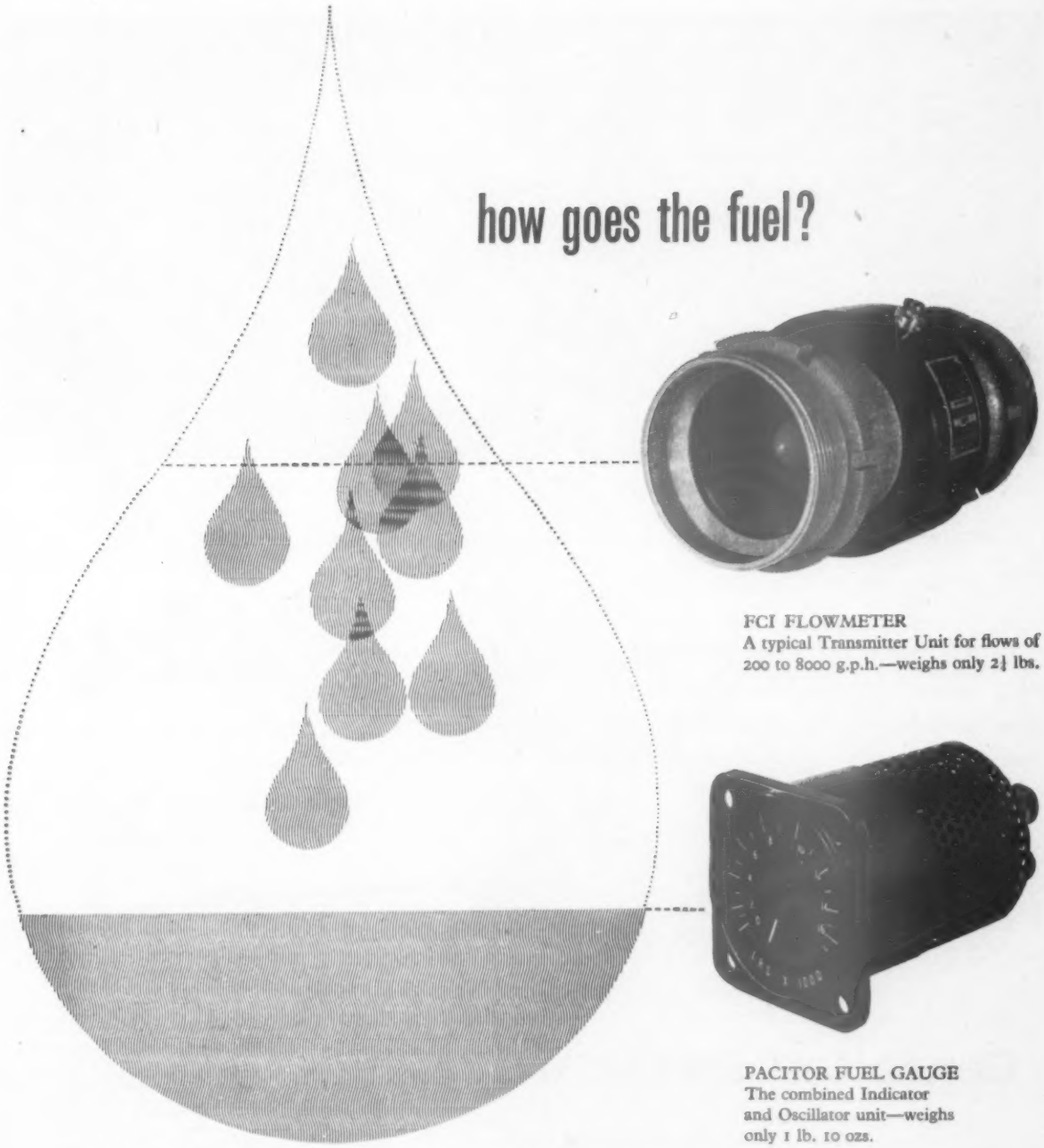

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CRC 40P

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(The diagram shows information required when ordering this type of spring.)

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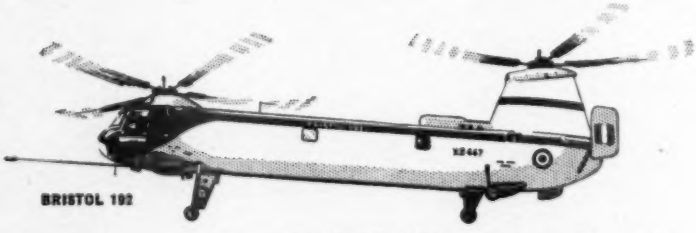

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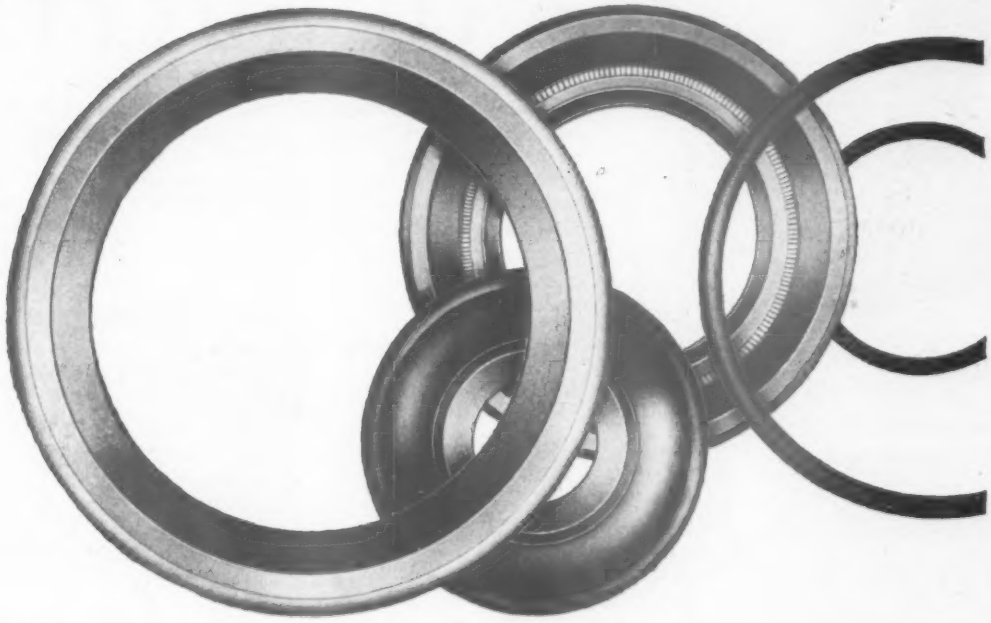

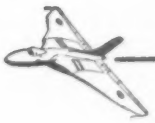

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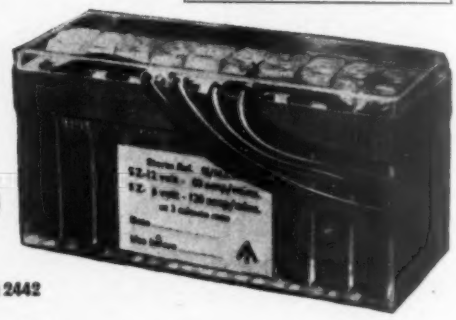

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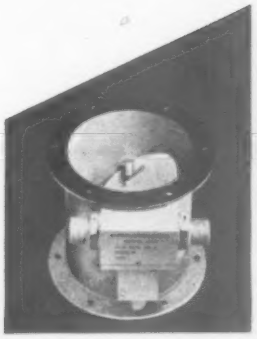

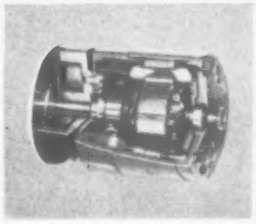

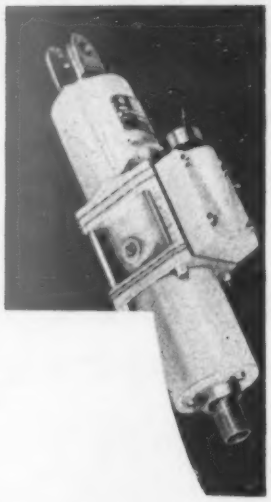

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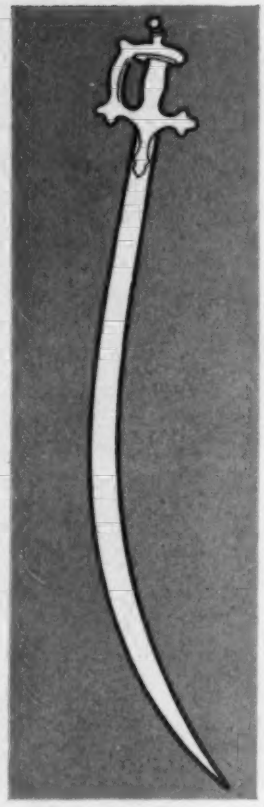

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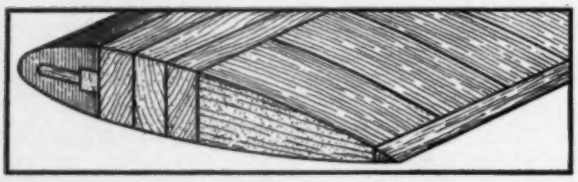

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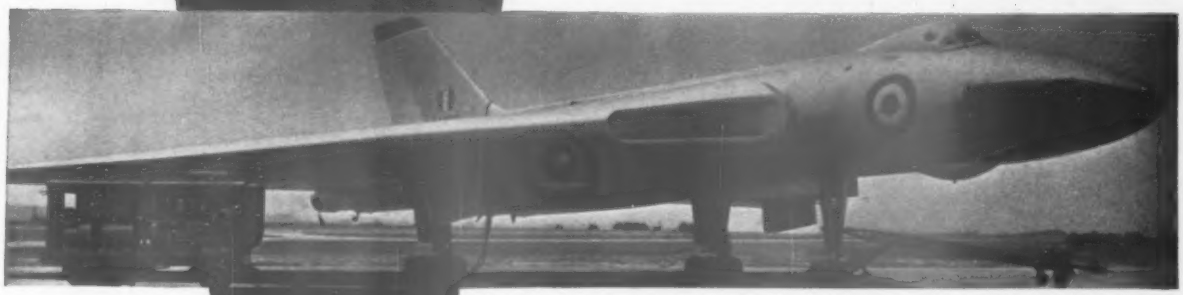

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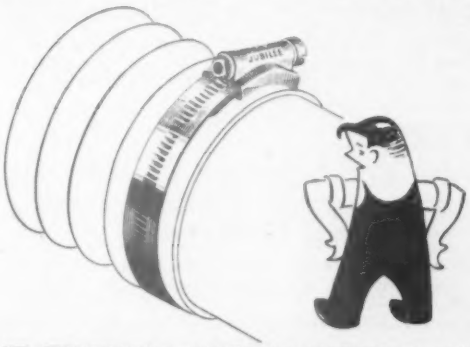

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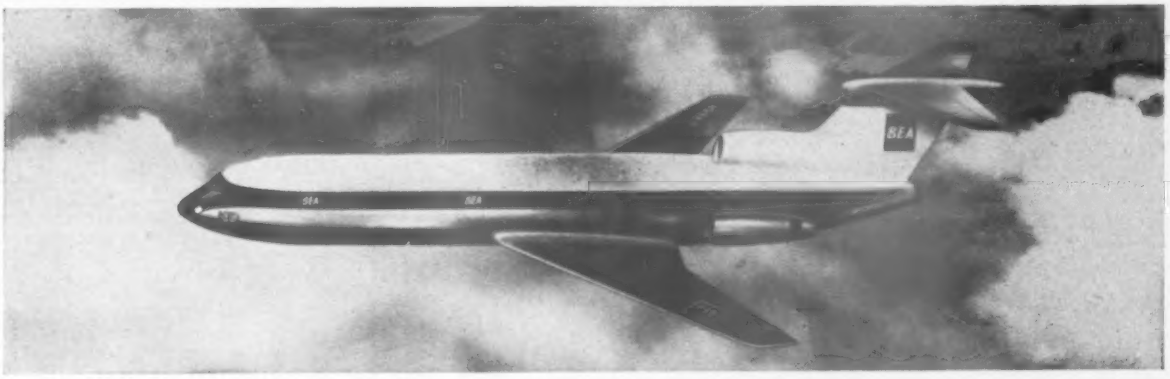

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NOTICES

AIR TRANSPORT ADVISORY COUNCIL

THE AIR TRANSPORT ADVISORY COUNCIL give notice that they have received the undermentioned applications to operate scheduled air services:—

FROM DERBY AVIATION, LTD., OF DERBY AIRPORT, BURNASTON, DERBY:—

(a) For the following services with Marathon and Dakota aircraft for the carriage of passengers, supplementary freight and mail at an initial frequency on each service, unless otherwise stated, of one return flight weekly increasing later in accordance with traffic demand, for seven years from 1960.

APPLICATION No. 3204 for a Normal Scheduled Service on the route Cardiff-Bristol-Amsterdam at an initial frequency of seven return flights weekly, increasing later in accordance with traffic demand, for seven years from date of approval.

APPLICATION No. 3211 for a Normal Scheduled Service between Luton and Brussels.

APPLICATION No. 3213 for a Normal Scheduled Service between Luton and Amsterdam.

APPLICATION No. 3210 for a seasonal U.K. Internal Service on the route Luton-Exeter-Newquay at an initial frequency of one return flight daily with Dakota aircraft or two return flights daily with Marathon aircraft, from May to September each year.

(b) APPLICATION No. 1586/1 for an amendment to the terms of approval of the Normal Scheduled Service which they are authorised to operate with Marathon, Dakota and Herald aircraft on the route Derby-Nottingham (opt.)-Birmingham (tech.)—Rotterdam at a frequency of one return flight daily until April, 1965, so as to enable them to operate on the route Cardiff and/or Bristol and/or Derby-Nottingham (opt.)-Birmingham (tech.)-Rotterdam.

(c) For the following Vehicle Ferry Services with Bristol Freighter aircraft, for the carriage of vehicles, freight and incidental passengers at an initial frequency, on each service, of four return flights daily increasing later in accordance with traffic demand, for seven years from 1960:—

APPLICATION No. 3212 BETWEEN LUTON AND LE TOUQUET.

APPLICATION No. 3214 BETWEEN LUTON AND CALAIS.

FROM OVERSEAS AVIATION (C.I.), LTD., OF 6 YORK ST., SAINT HELIER, JERSEY, C.I., for the following Normal Scheduled Services, to be operated for seven years from 1960:—

APPLICATION No. 3205 for a seasonal service with Argonaut aircraft, for the carriage of passengers, supplementary freight and mail between Liverpool (Speke) and Palma, at a frequency of two return flights weekly on any day except Saturday, from May to October each year.

APPLICATION No. 3206 for a service with Viking and Argonaut aircraft for the carriage of passengers only, on the route Liverpool and/or Manchester-Frankfurt (Opt. Tech.)-Munich, at an initial frequency of two return flights weekly increasing later in accordance with traffic demand.

FROM CONTINENTAL AIR SERVICES, LTD., OF 29 HILL ST., SAINT HELIER, JERSEY, C.I.:—

APPLICATION No. 3207 for a Normal Scheduled Service with DC-4 aircraft for the carriage of passengers, supplementary freight and mail on the route London (Blackbushe)-Rome (Tech.)—Tel Aviv at a frequency of two return flights weekly for seven years from May, 1960.

FROM DON EVERALL (AVIATION), LTD., OF BIRMINGHAM AIRPORT, BIRMINGHAM, 26:—

APPLICATION No. 3208 for an all-freight service with DC-3 aircraft between Birmingham and Shannon at a frequency of seven return flights weekly for seven years from date of approval.

FROM EAGLE AIRWAYS, LTD., OF 40 EDGWARE RD., LONDON, W.2:—

APPLICATION 767/2 for permission to operate DC-6C aircraft in addition to the types at present authorized on the following Normal Scheduled Services:—

APPLICATION No. 767 approved with Viking, Dakota and Viscount aircraft on the route Manchester (Ringway)-Southend (Opt.)-Luxembourg at a frequency of seven return flights weekly, until June 19, 1963.

APPLICATION No. 1430 approved with Viking aircraft on the route Manchester (Ringway)-Luxembourg (Opt.)-Innsbruck, at a frequency of seven return flights weekly, until April 30, 1965.

FROM BRITISH OVERSEAS AIRWAYS CORPORATION, OF LONDON AIRPORT, HOUNSLOW, MIDDLESEX:—

APPLICATION No. 67/1 for an extension from September 2, 1959, to September 2, 1966, of the period of approval of the Normal Scheduled Service which they are authorized to operate on the route London-Lisbon-Casablanca-Dakar-Recife-Rio-de-Janeiro-Sao Paulo.

These applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on July 30, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. 499-14

SITUATIONS VACANT

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B.E.A. Require radio maintenance engineers based in line pool at London Airport, to undertake relief duties at U.K. and overseas stations. Applicants should have considerable experience of aircraft radio servicing and maintenance, a knowledge of modern airborne civil radio communication and aircraft electrical systems, landing and navigational aids, and possess a current Aircraft Radio Maintenance Engineer's licence to at least A category with A rating. Medical fitness for overseas service is essential in all cases. Salary £937 10s. to £1,067 10s. plus allowances on posting. Write to Senior Personnel Officer, Area and Outstations, British European Airways, Keyline House, Ruislip, Middlesex. 499-9

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THE Air Ministry have vacancies for civilian Radio Technicians at Royal Air Force Sealand and at other selected R.A.F. stations throughout the United Kingdom for the servicing, repair, modification and testing of air and ground radio and radar equipment. Commencing salary (National) (according to age) is £525-£670 p.a. Maximum salary, £795 p.a. These rates are subject to a small deduction at certain provincial stations and a small increase in London. Annual leave 3 weeks 3 days increasing to 4 weeks after 3 years service. A limited number of houses may be available for renting at Sealand. These houses are at West Kirby some 15 miles distant. Apply, giving details of qualifications and experience direct to the Commanding Officer, No. 30 Maintenance Unit, Royal Air Force, Sealand, or to Air Ministry, C.E.4b, Cornwall House, Waterloo Rd., London, S.E.1, for vacancies in other areas. 499-3

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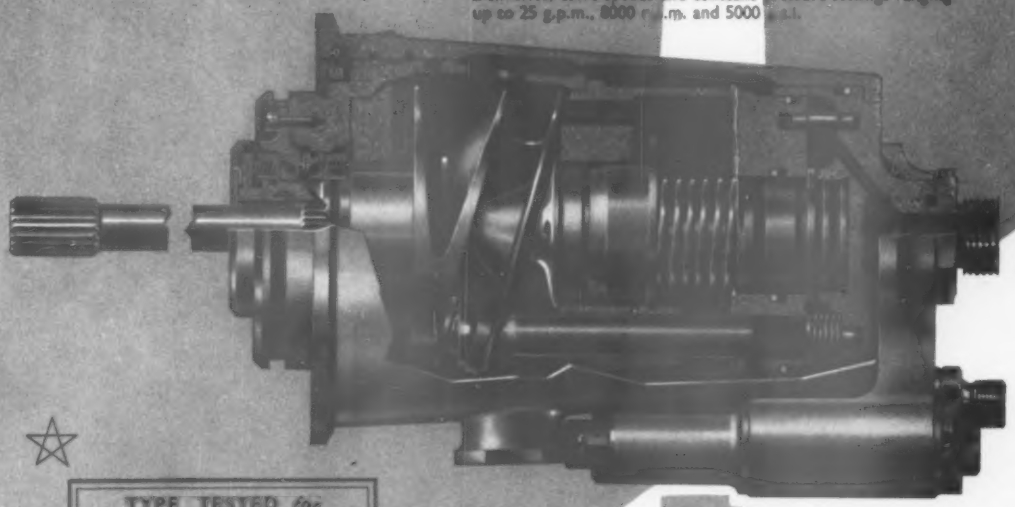

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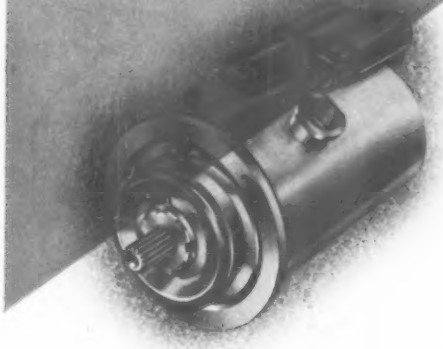

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